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NUTRITIONAL STATUS, DEVELOPMENT AND IMMUNIZATION IN BABIES BORN TO COVID-19 POSITIVE MOTHERS

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LIST OF ABBREVIATIONS

1. COVID-19 : Corona Virus Disease
2. SARS-CoV-19: Severe acute respiratory syndrome Corona virus 2
3. MERS: Middle East Respiratory Syndrome
4. SARS: Severe Acute Respiratory Syndrome
5. VPD: Vaccine Preventable disease
6. WHO: World Health Organization
7. ASQ-3: Ages and Stages Questionnaire 3
8. RT-PCR: Real-Time Reverse Transcription Polymerase chain reaction
9. IgA: Immunoglobulin A
10. RI: Routine Immunization
11. SD: Standard Deviation
12. NVD: Normal Vaginal Delivery
13. LSCS: Lower segment caesarean section
14. NICU: Neonatal Intensive care unit
15. LBW: Low birth weight
16. VLBW: Very Low birth weight
17. ELBW: Extremely Low birth weight
18. χ^2: Chi square test
19. OR: Odds ratio
20. 95% CI: 95% Confidence interval
21. BCG: Bacillus Calmette Guerin
22. OPV: Oral poliovirus vaccine
23. DTwP: Diphtheria, tetanus, whole cell Pertussis
24. DT: Diphtheria and tetanus toxoids
25. TT: Tetanus toxoid
26. Hep B: Hepatitis B vaccine
27. MMR: Measles, Mumps and Rubella Vaccine
28. Hib: Hemophilus influenzae Type ‘b’ Vaccine
29. IPV: Inactivated poliovirus vaccine
30. Td: Tetanus, reduced dose diphtheria toxoid
31. HPV: Human Papilloma Virus Vaccine
32. PCV: Pneumococcal Conjugate Vaccine
33. TdaP: Tetanus and Diphtheria Toxoids and a Cellular Pertussis Vaccine

Introduction

INTRODUCTION

COVID-19 is an infectious disease caused by coronavirus (SARS-CoV-19). Coronaviruses are a family of viruses that causes illnesses like the common cold, MERS (Middle East Respiratory Syndrome), SARS (Severe Acute Respiratory Syndrome), etc.

The disease can spread from human to human through small droplets from the nose or mouth which can spread when a person with COVID-19 coughs or exhales and another human comes in contact with droplet either directly or through fomite. (1)It has an incubation period of 2-14 days and viral shedding has been reported in pre-symptomatic and asymptomatic carriers. India reported its first case of COVID-19 in Kerala on 30th January 2020, and until 15th December 2020(2), India has reported over 100 lakh cases with approx. Over 1 Lakh deaths.

Various steps have been taken to curb the spread of coronavirus, Social distancing has been a vital intervention strategy to curtail community transmission during this COVID-19 pandemic. Although these strategies are essential, concerns have arisen regarding lengthy home quarantine, which may negatively impact children's social, mental, and physical health along with basic development, vaccination, and nutritional derangement.

Strict home quarantine also leadsto healthcare services being disrupted which further lead to delays or missing of childhood immunization, which is a significant concern.

Vaccine-preventable disease (VPD) remains an important concern that requires obedience to recommendations to prevent several severevaccine-preventable illnesses in children.(3) Delayed or missed vaccination makes children susceptible to certain preventable diseases and may also disrupt herd immunity. According to the World Health Organization (WHO)currently, VPD is a threat to 80 million children worldwide because of the interruption of healthcare systems due to the current COVID-19 pandemic.(4)

In addition, vaccination against influenza may help decrease the rigorousness of disease in patients who experience co-morbid COVID-19 infection and influenza infections. Administering vaccinations in a timely manner is fundamental but may be affected by various external factors.

Natural disasters, for example, may have a negative impact on vaccination rates and timeliness, leading to infectious disease outbreaks, similar impact has been observed due

to COVID-19 outbreak. Along with the negative burden of the disease outbreak, a few positive aspects with respect to immunization can also be observed. Generalized urge for the need for vaccines against COVID-19 has also enabled layman to think about various other vaccine-preventable diseases and protection for the same.

Mother and baby separation is a problem of great consideration during the Covid-19 pandemic. All COVID positive patients are quarantined for 14 days to avoid the spread of Covid-19. Even after the end of quarantine, attendants continued to separate mothers from their babies due to the fear of uncertain infection.

Lesser population opted for breastfeeding in the early months fearing transmission of infection to the newborn. Other thanthe early cessation of breastfeeding, early baby-mother separation is also linked to negative effects on achild's brain development, parent's psychological well-being, and the parent–infant relationship(5), (6) .

Such conditions of stress during the prenatal and early childhood periods are negatively associated with later impairments in learning, behavior, development and both physical and mental well-being. (7).

Nature has designed a mother's breast milk to take care of the neonate and to shield of the dyad in "psyche and soma", ensuring the transfer of antibodies, microbes, and viruses, but also emotional stimulation.

On May 27, 2020, WHO updated Interim Guidance on Clinical Management of COVID-19, exclusive breastfeeding for first 6 months at least followed by breastfeeding along with complementary feeds until 2 years of age while using necessary precautions for transmission of infection and prevention and control in infants born to mothers with COVID-19 infection (WHO 2020) (8).

These guidelines and recommendationswere based on the major health benefits associated with breastfeeding for both the mother and the child and the comparatively lesser risk of mild or asymptomatic illness experienced by infants. Breast milk has innumerable benefits for newborns,like transmission of passive antibodies against various infections building a stronger immune system, mother and child bonding, andprovides most of all nutrients required for the baby.(9)

Antibodies against the virus are present in the human milk of mothers who have previously been infected with COVID-19 infectionand it is possible that breast milk from

these mothers will provide some degree of immunity. Thus, most international associations highly advocate using breast milk from mothers with confirmed or suspected COVID-19. Careful collection techniques should be used for mothers opting for expressed breast milk. Providing every mother with a breast pump. Mothers should practice hand hygiene before and after pumping, and the breast pump should be properly disinfected as per the instructions.

If possible, expressed breast milk can be fed to newborns by a healthy caregiver by spoon/ paladai.

In cases where a mother with confirmed or suspected COVID-19 chooses to directly breastfeed, she should take significant precautions like wearing a surgical mask and performing hand and breast hygiene prior to feeding. When the mother is not breastfeeding, the infantshould remain >2 m (~6 ft) away and must be separated by a barrier.

NEED FOR STUDY

- Little is known about the possible consequences of severe acute respiratory syndrome, Corona virus 2 (SARS-CoV-2) infections in pregnant women and its outcome on new born child.
- Delayed cord clamping, breast feeding, mother and child touch, 0 dose vaccines at birth have innumerable advantages. These practices could not fully be achieved in view of lesser known evidence on modes of transmission of the virus.
- Combined impact of all such precautionary steps taken in view of protecting the neonate from getting infected with COVID-19 infection, and its affect on the child's nutritive, developmental and immune sectors are unknown.
- Hence, there is a need to conduct this follow up study.

Aims

&

Objectives

AIMS

1. To assess for feeding practices of babies born to COVID-19 positive mothers.
2. To assess Immunization according to National immunization schedule till 12 months of age in babies born to COVID 19 mothers.
3. Development milestones by history and examination and assessment by ASQ – 3 (ages and stages questionnaire- 3rd edition) in babies born to COVID 19 mothers.

OBJECTIVES

1. To assess for changes in feeding practices during and prior to COVID pandemic
    - Upto 6 months
    - At 12 months

2. To assess delay in immunization according to National immunization schedule up till 12 months of age due to COVID 19 Pandemic.

3. To assess development milestones by history, examination and assessment by ASQ – 3 (ages and stages questionnaire- 3rd edition) scale at 6 months and 1 year in the following domains:
    - Cognitive
    - Gross motor
    - Fine motor
    - Problem solving
    - Personal social

Review

of

Literature

REVIEW OF LITERATURE

A Review of the literature is one of the basic foundations for all Research work. To date, there are very few reports regarding the impact of the COVID-19 pandemic on childhood immunization, nutrition, or development.

SARS-COVID-19 virus has infected the vast majority of people all over the world including pregnant women. Limited research is available on the effect of SARS-COVID-19 virus on perinatal transmission, transmission via breast milk, or impact on children born to mothers infected with SARS-COVID 19 virus.

Tolu et al. in study on Vertical transmission of Severe Acute Respiratory Syndrome conducted a study with screening of newborns for COVID-19. Of the study population, only 4.4% tested positive for throat-positive RT-PCR delivered via LSCS. Among neonates who had throat swabs SARS-CoV-2 positive only five (33.3%) had associated placenta, amniotic fluid, and cord blood samples analyzed, of which only one amniotic fluid sample was positive for RT PCR. Four neonates had chest CT scan suggestive of COVID-19 pneumonia. Concluding, currently there is not enough confirmation on the vertical virologic transmission of COVID-19 infection during the third trimester of pregnancy. Additionally, there is no evidence to support cesarean delivery as a mode of delivery or abstaining from exclusive breastfeeding or mother and infant separation. Further research concerning an adequate sample size of amniotic fluid, placenta, breast milk, and cord blood to determine the possibility of vertical transmission and breast milk transfer is needed. (10)

1. NUTRITION

Beyond somatic growth, breast milk as a biological fluid has a variety of other benefits, including brain development, modulation of postnatal intestinal function, immune ontogeny, etc.(11)

Breast milk is undoubtedly the superior milk for infants, providingprotection and ideal nutrition against infection. Exclusive breastfeeding up until 6 months (weaning) provides the healthiest start in life. Formula milk are the only suitable alternative from birth and during the first year of life. Ascompared to breast milk, some nutrients are less well absorbed and formula milks doesn't contain anti-infective agents to shield against infections. (12)Cow's milk is not suitable as a drink before 12 months of age.Exclusive

Breastfeeding is recommended by World Health for the first six months of life .(13) The American Academy of Pediatrics also recommends breastfeeding for at least 12 months. Complimentary feeding should be started by 6 months of age. (14)

Benefits of breast milk:(15)

- It is a complete food for the infant and contains all the considered necessary nutrients for his/her first 6 months in balanced proportions and sufficient quantities.
- It helps in adequate growth and development, thus preventing stunting.
- It contains essential antibodies that protect against various diseases, especially against diarrheal diseases and respiratory infections.
- It is always atthe right temperature.
- It is easy to digest and is suitable for the child.
- Nutrients are well absorbed.
- It protects against allergies. Breast milk antibodies (IgA) protect the baby's gut from harmful substances to pass into the blood.
- It contains enough water for the baby's needs (breast milk contains87% of water and minerals).
- It helps jaw and teeth development (suckling develops facial muscles.)
- Frequent skin-to-skin contact between feeding mother and infant leads to better emotional, psychomotor,and social development of the child.
- Colostrum is essential for the child as it has numerous protective antibodies and also acts as a laxative, accelerating better gut motility.

COMPARISON of Breast milk, formula milk for infants and animal milk.(16), (17)

	BREAST MILK	FORMULA MILK FOR INFANTS	ANIMAL MILK
CALORIES (KCAL/L)	747	700	701
PROTEIN(g/100ml)	1.1	1.5	2.8

CASEIN	3.7		25
TAURINE(mM/100ml)	25-30	ARTIFICIALLY ADDED	<1
PHENYLALANINE(mg/100ml)	48	390	172
TYROSINE	61		179
FAT(g/1000ml)	4.5	2.6	4.4
CHOLESTEROL(mg/l)	139	0	120
CARBOHYDRATE(g/1000ml)	6.8	7.2	4.7
MINERALS(wt%)	0.2	0.33	0.7
CALCIUM(mg/dl)	34	55	118
PHOSPHORUS(mg/dl)	14	44	93
CALCIUM/ PHOSPHORUS RATIO	2.4:1	1.2:1	1.3:1
SODIUM(GM/L)	0.512	1.1	0.76
VITAMIN D	4-40(IU/L)	400(IU)	47-100IU
VITAMIN K	0.9-6.9MG/L	4MG/100KCAL	19MG/L

The possible transmission of COVID-19 through breast milk and breastfeeding (i.e., any related bodily fluids, such as respiratory droplets, blood, and sweat) or droplet transmission due to close contact with the infant or young child via skin-to-skin exposure or airborne transmissionremains unclear.

In a study conducted by Centeno-Tablante et al.on the transmission of SARS-CoV-2 through breast milk and breastfeeding considered Pregnant or lactating women with suspected, probable, or confirmed COVID-19 infection as well as their infants or young children (0–24 months of age) regardless of breastfeeding status, with suspected or confirmed COVID 19 infection, were taken into study. The review concluded Breast milk samples were only tested by RT-PCR assays, and it is possible that viral RNA detection in breast milk was affected by the component of breast milk that was tested, as it has been shown to affect the sensitivity in other contexts. Some degree of evidence suggests that SARS-CoV-2 RNA is detected in human milk in a tremendously low proportion; however, based on current evidence, infectivity and impact of the infants cannot be concluded. In concordance with WHO recommendations, exclusive breastfeeding should be recommended in all cases unless any other contraindication exists. (18) , (8)

Study conducted by Vassilopoulou et al. on Breastfeeding and COVID-19 concludedthemost abundant antibody in breast milk, sIgA, provides specific protection against pathogens adequately, among which also are viruses. The specificity of sIgA is invariably determined by the immune response of the mother to previous infections, explaining the low rates of infection or comparatively milder symptoms of the infected breastfed infants of SARS-CoV positive mothers. Protectiveefficacy of exclusive breastfeeding against viral infections, and maternal contact of the breastfed infant in comparison to the infant receiving Top feeding or mixed feeding and the high transmissibility of SARS-CoV, protecting measures should be strictly detected for safeguarding the lactation course. (19) Breastfeeding was strongly encouraged where both members of the dyad were positive and further investigation was suggested on the role of IgG antibodies in the possible protective role of antibodies of breast milk on the immunity of infants· Among the breast milk samples tested for SARS-CoV-2, 27% (3/11) were positive but the milk was not considered to be the cause of infection of the infants.

Szczygiol et Al conducted a study at Wroclaw Medical Teaching Hospital, Poland on antibodies in breastmilk of COVID 19 recovered women concluded presence of SARS-CoV-2 IgA and IgG antibodies in the breastmilk of COVID-19 recovered women and the possibility of these antibodies in providing particular immunologic benefits to breastfeeding infants such as protection against the virus transmission and severity of the acquired COVID-19 disease. (20)

A scoping review conducted by wesolowska et al. on protecting breastfeeding during the COVID 19 Pandemic concluded recommendations to allow and encourage breastfeeding by mothers infected with SARS-CoV-2, as being raised most often by global and national authorities, despite very limited initial knowledge of the risk of transmitting the SARS-CoV-2 through this route from mother to child. However, lack of rational, evidence-based recommendations and often contradictory character of guidelines issued by well-established authorities was a problem discussed by the authors of the recommendations.(21)

Bharadva et Al, in Statement of Indian Academy of Pediatrics and Infant and Young Child Feeding Chapter recommended Breastfeeding and KMC in providing Nutrition and prevention of Infection. Encouraging breastfeeding taking appropriate sanitary measures and prevention of droplet transmission by using mask. They also encouraged expressed breast feeding practices in critically ill patients. (22)

Relationship and Impact on Breastfeeding, A Systematic Review conducted by Pérez-Bermejo et al. in Spain concluded there is a transmission of antibodies against SARS-CoV-2 through breastmilk, it does not appear to be contagion of the disease. SARS-CoV-2 RNA has been found inbreastmilk, but no viable SARS-CoV-2 viruses. Thus, infants can benefit from the direct acquisition of antibodies against SARS-CoV-2 through breast feeding. (23)

2. IMMUNIZATION

The worldwide progression of the COVID-19 pandemic may disrupt critical services such as routine immunization (RI) which are lifesaving.Thus, increasing the susceptibility of outbreaks of various vaccine-preventable diseases (VPDs) in several countries. Being endemic to various infectious diseases, India as a country might be at increased risk of outbreaks as the utilization of routine immunization services might have deteriorated due to the COVID-19 pandemic.

Vaccines are administered in such way that the vaccination precedes the age at which that particular disease occurs. Vaccination being an essential for every child, must be started as soon as possible after birth. The current immunization schedules, IAP Immunization Schedules, have been summarized in Table.

IAP (Indian Academy of Pediatrics) Recommendations (birth to 1 year)(24)

Age	Vaccines
Birth	BCG, OPV 0, Hepatitis B -1
6 weeks	DTwP-1, Hepatitis B -2, Hib -1, Rotavirus 1, PCV 1, IPV-1
10 weeks	DTwP-2, Hib -2, Rotavirus 2, PCV 2
14 weeks	DTwP-3, IPV-2 , Hib -3, Rotavirus 3, PCV 3
6 months	OPV 1, Hep B 3
9 months	OPV 2, MMR-1
9-12 months	Typhoid Conjugate Vaccine
12 months	Hep-A 1

Catch-up vaccination for children who have missed vaccination (up till age 12 months for purpose of this study) (25)

VACCINE	CATCH-UP
Hepatitis B (minimum age- birth)	• Unvaccinated children should complete a 3-dose series. • A 2-dose series (doses separated by at least a period of 4 months)
Rotavirus vaccines(RV). Minimum age: 6 weeks for both RV1 (Rotarix) and RV5 (RotaTeq)	• The maximum age for the first dose in the series is 14 weeks, 6 days • vaccination should not be given to infants aged 15 weeks, 0 days or more. • The maximum age for the final dose in the series is 8 months, 0 day.
Hepatitis A (HepA) vaccine. (Minimum age: 12 months)	• The minimum interval between the two doses is 6 months.
Haemophilus influenzae type b. Conjugate vaccine. (Minimum age: 6 weeks)	• If 1st dose was given at ages 12 through 14 months, give a second dose at least 8weeks after dose 1. Regardless of Hib vaccine used in the primary series. • If the first dose was given at age 7 through 11 months, give the second dose at least 4weeks later and a third (and final) dose at age 12- 15 months or 8 weeks after second dose,whichever is later, regardless of Hib vaccine used for first dose. • If first dose is given at younger than 12

	months of age and second dose is given between 12-14 months of age, a third (and final) dose should be given 8 weeks later. • For unvaccinated children aged 15 months or older, give only 1 dose
Pneumococcal vaccines. (Minimum age: 6 weeks for PCV13, 2 years for PPSV23)	• Give 1 dose of PCV13 to all healthy children aged 24 - 59 months who are notcompleted vaccination for their age.
Varicella vaccine (VAR). (Minimum age: 12 months)	• minimum interval between doses is 3 months(if the second dose was given at least 4 weeks after the first dose, it can be accepted as valid)
BCG (minimum age: birth)	1 dose if <12 months
Measles, mumps, and rubella (MMR) vaccine. (Minimum age: 12 months for routine vaccination)	Ensure that all school-aged children and adolescents have had 2 doses of MMR vaccine; the minimum Interval between the 2 doses is 4 weeks.

The national childhood immunization schedule currently targets

16 Vaccine preventable Diseases (VPD) at various stages, beginning at birth, 2, 4, 6, 9, 12, 18 and 24 months. The vaccines are for polio, hepatitis B, bacillus Calmette–Guérin (BCG), diphtheria–tetanus–pertussis, Hemophilus influenzae type B,rotavirus, hepatitis A, pneumococcal infections, varicella, meningococcal infections, measles-mumps-rubella (MMR) and human papillomavirus (HPV).

Study conducted by Alsuhaibani et al. in Department of pediatrics, Qassim university, Saudi Arabia, South Asia were a cross sectional study was conducted using an self-administered online questionnaire comprising of 25 questions. The questionnaire was designed to measure the frequencyofand reasons for the delay in childhood vaccinations during the COVID-19 pandemic in Saudi Arabia. The study population incorporated parents from different areas of the Qassim region who had children under two years of age during 1 March to 30 June 2020 time period. Parents who did not have children below the age of two were not included in the study. Sampling of parents via the WhatsApp application using the Google platform between 1 May and 30 June was done conveniently. Nearly 3/4th (73.2%) of the parents had appointments scheduled for their child's routine childhood vaccination during the COVID-19 pandemic, approximately 23.4% of the parents reported more than one month of delay in routine childhood immunization of their child. The most widespread reason for the delay was the panic of being infected by COVID-19 (60.9%). Concluding, Childhood immunization has been affected in Saudi Arabia due to COVID 19 pandemic.(26)

A Study of the Impact of Lockdown on Vaccination Coverageat a Tertiary Care Center It was a retrospective analytical study carried out by Vasavada et al.at Shardaben Hospital, Saraspur, Ahmedabad, Gujarat, India. The study period was April–May 2019 to April–May 2020 which concluded

There has been noteworthy reduction in attendance to the immunization clinic for routine childhood vaccination during the lockdown period secondary to coronavirus pandemic. The decline has been more in May 2020 as compared to April 2020 because of increase in number of cases during that time period in the area with it being declared as containment zone during that period.(27)

Similar study conducted in Sindh, Pakistan by Chandir et al. extracted child immunization records from real-time provincial Electronic Immunization Registry from time period of September 23, 2019, to July 11, 2020. There was a 52.5% turn down in the daily average total number of childhood vaccinations administered during COVID-19 lockdown compared to baseline. The highest decline was seen for (BCG) Bacille Calmette Guérin vaccine. One in every two children in Sindh, Pakistan had missed their vaccinations during the COVID-19 lockdown. Concluding, the pool of un-immunized children is expanding exponentially during lockdown, leaving them susceptible to vaccine-preventable diseases. (28)

Department of Social and Cultural Anthropology, University of Vienna, Austria,evaluated the Impact of COVID-19 on vaccination programs: adverse or positive.COVID-19 pandemic has emerged as a greater global public health concern than any other occurrence in living memory. This pandemic may have significant effectson the efforts and programs concerning other vaccine preventable diseases chiefly intwo ways, one negative and the other positive:

COVID-19's negative effects include the hesitancy of routine vaccination programs due to the rising need for resources to handle COVID-19 and to scrutinize the required physical isolations and quarantines necessary for curtailing its transmission. Hence, millions of babies might have to receive delayed vaccines, such as OPV 0 and BCG (birth vaccines) especially those who will not be delivered in the hospitals of high-income countries. Deliveries in the rural clinics or homes oflow-income countries where viruses like poliomyelitis and measles are already prevalent are at greater risk. Vaccination uptake will also be substantially affected in order age groups amongst children, who may miss scheduled childhood vaccinations due to quarantines as well as to the resources being channelized at stopping COVID-19. This unintentional lack and lag of routine childhood vaccination may cause outbreaks of other Vaccine preventable diseases, consequently exerting further adverse impacts on preventable diseases and COVID-19-affected economies and healthcare systems.

COVID-19's positive impact on vaccination programsincludethe fact that the rapid spread of this virus may significantly affect people's overall perception of vaccination due to their desire for a COVID-19 vaccine. This desire may result in increased awareness of the benefits of vaccination programs in general, eventually resulting in a considerable increase in vaccination uptake. Therefore, once the need for social distancing is over, there will occur a prime momentfor reinstituting all vaccination programs.(29)

Spencer et al. studied The Impact of COVID-19 Pandemic on Inequity in Routine Childhood Vaccination Coverage,A Systematic Review reported higher rates of inequity among children aged less than one year during the COVID 19 pandemic.They also concluded Research from more countries over all is required to assess the global effect on inequity in coverage. (30)

Impact of COVID-19 pandemic on the utilization of routine immunization services in Lebanon, study by Mansour et Al stated Among vaccines administered in the public sector, the maximum negative percentage change was observed in vaccination of measles vaccines (38%) followed by polio vaccine OPV (28%). Survey respondents estimated an overall refusal in the utilization of Routine immunization by 46.9% in the private sector. On average, survey respondents estimated an overall refusal in the utilization of routine immunization by 46.9% in the private sector. Reduction rates in the provision of specific vaccines ranged between 46% to 58% with the highest being reported for polio (OPV) (57.5%) and hepatitis A vaccines (57.2%) followed by PCV (53.3%), measles, (53.3%) and MMR vaccines (49.9%). The lowest percent decrease rate among the inspected vaccines was attributed to DPT-containing vaccines (46.3%) . (31)

3. **DEVELOPMENT**

Comprehensive tests for development assessment such as The Bayley Scale of Infant and Toddler Development and The Mullen Scales of Early Learning are frequently referred to as the gold standard in the developmental evaluation of young children and infants. These tests have comprehensive information on a child's existing developmental status, are run directly with the child, offer normative scores for the area which are assessed, and psychometric characters are shown to be highly satisfactory. These comprehensive development assessment tests require thorough training of personnel, preferable professionals with good clinical experience within the age group, and running these assessments is often time-consuming.

The Ages and Stages Questionnaire 3 edition. (ASQ-3) is a widely used screening tool for infants and young children's development assessment. ASQ-3 assesses development in five major domains: Communication, Gross Motor, Fine Motor, Problem Solving and Personal Social. (32) The screening tool was developed in the US, has a US standardized sample and its use has been well-known in assessing development in children aged 1 – 66 months which iseconomical with cut off scores identifying developmental delays.

ASQ-3 "home procedure "can be used as an easily administered and economical assessment tool for the collection of data on developmental grade in infants and young children. (33)

Neuro-developmental outcomes of infants born to mothers with SARS-CoV-2 infections during pregnancy a national prospective study done in Kuwait by Ayed et al. used ASQ-3 scores. Subjects were classified into developmental delays (cutoff scores ≤ 2 standard deviations (SDs) below the population mean) and no delays (scores > 2 SDs above the population mean) concluded majority (90%) of the infants born to mothers with SARS-CoV-2 infections during pregnancy had positive outcomes and only 10% showed delay in developmental. Threat of developmental delays among infants was higher in those infants whose mothers had SARS-CoV-2 infections during the first (P = 0.039) and second trimesters (P = 0.001) than in those infants whose mothers had SARS-Co-V2 infections during the third trimester. (34)

Huanget al.studied the association Between the COVID-19 Pandemic and Infantile Neurodevelopment A Comparison Before and During COVID-19 The experience of the pandemic in 2020 was associated with a higher incidence of delay in the fine motor (adjusted OR: 2.50, 95% CI: 1.25, 4.99; estimated by logistic regression) and communication skills (adjusted RR [aRR]: 1.13, 95% CI: 1.02, 1.25; estimated by log-binomial regression) domains at age 1 year. The association between the experience of the pandemic and communication delay at age 1 year only existed in the first-born child (aRR: 1.15, 95% CI: 1.03, 1.30) but not in later-born child (aRR: 1.02, 95% CI: 0.84, 1.25). No associations were observed in any domain among 6-month-olds. (35)

Not much study has been done on the Neuro-Developmental outcome of Infants born to SARS-COVID positive mothers. Limited research on the subject entitles for further workup and study on the same.

Material

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Methods

MATERIAL AND METHODS

The present study titled "**NUTRITIONAL STATUS, DEVELOPMENT AND IMMUNIZATION IN BABIES BORN TO COVID-19 POSITIVE MOTHERS** " conducted in the department of Pediatrics, Santosh Medical College and Hospital has been approved by Institutional ethical committee and review board.

STUDY DESIGN: Prospective observational study

PLACE OF STUDY:

The cases were enrolled in the proposed study from Department of Paediatrics , Santosh Medical College and Hospital, Ghaziabad, India.

SAMPLING FRAME:

Children who were born to COVID-19-RTPCR positive mother and took birth at Santosh Medical College and Hospital.

SAMPLE SIZE:

For the proposed prospective observational study, all the cases available during the study period from 1 July 2020 to 1 July 2021 were enrolled in the analysis. Total cases enrolled in the study are102. Of which 83 actively participated. 3 infants expired, 16 infants were lost to follow-up due to refusal to be a part of the study or unable to contact.

INCLUSION CRITERIA:

- All babies born to mothers who tested positive during their pregnancy in between July 2020 to July 2021.

EXCLUSION CRITERIA:

- Non consenting attendants.
- Children born to mothers with COVID-19 negative status.

METHODOLOGY:

Santosh Medical College and Hospital was declared as Level- 3 dedicated COVID Facility from 30 March 2020 to 30 august 2021.

Children born to mothers with COVID-19-RTPCR positive status were enrolled in the study and detailed information was collected and tabulated for the purpose of this study.

- **Detailed case sheet created consisting of:**

A. At the time of delivery : Gestation age, Gravida status, Sex, weight, Mode of delivery, time of delivery, any associated complications.

B. Mother was advised for exclusive breast feeding for first 6 months, birth immunization and need for regular follow up.

C. Follow up was done at 6 months and 12 months

D. At 6 months: Feeding practices, immunization status, and development according to ASQ-3 questionnaire.

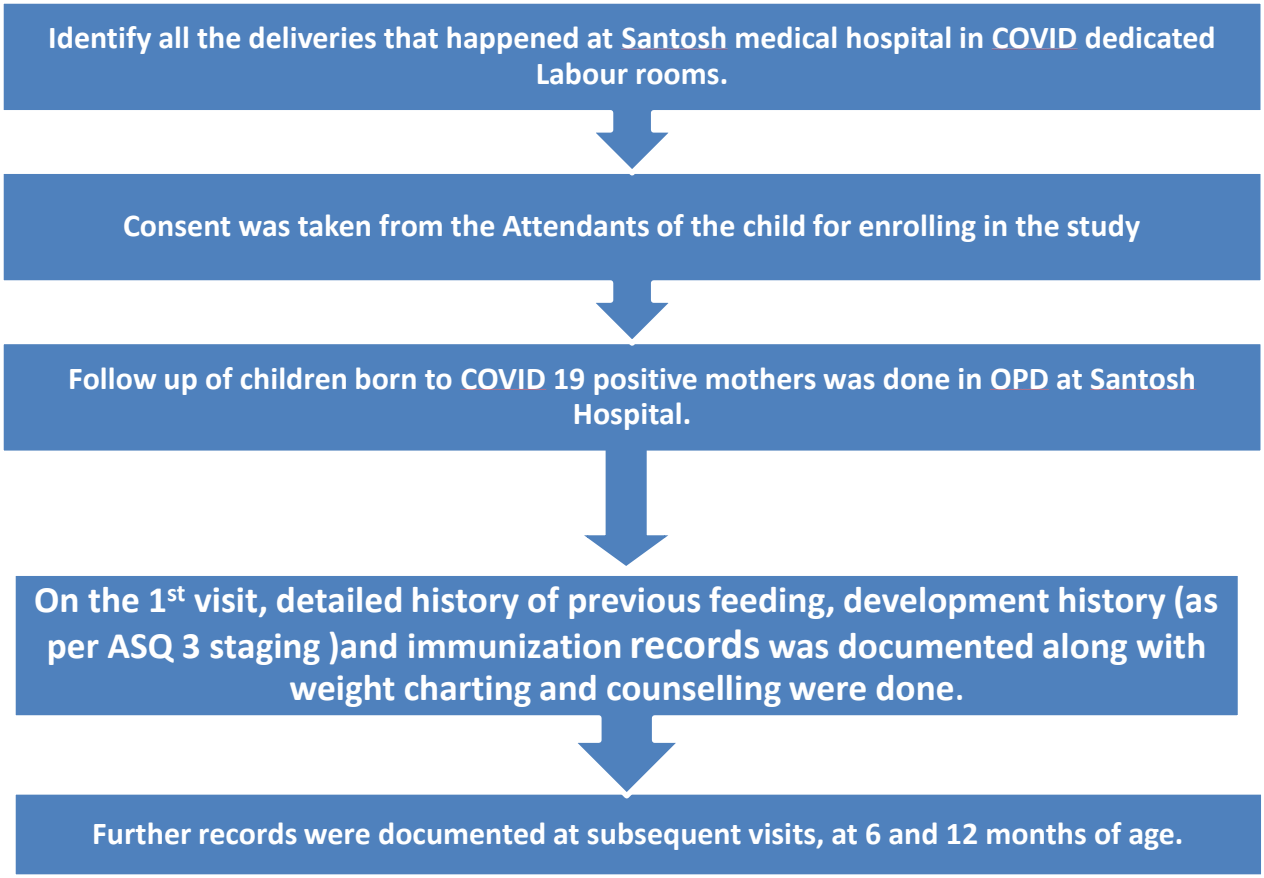
E. At 6 months: Feeding practices (initiation of complementary feeds), immunization status, and development according to ASQ-3 questionnaire.

- **Data Collection:** Data was collected and tabulated which has been obtained through guardian through interviews and clinical examination.

- Historical Data from Santosh Medical College and Hospital from period of 1 March 2019 to 1 January 2020 was taken to compare the data.

STATISTICAL ANALYSIS

Statistical analysis was done using MS Excel and STATA. Basic descriptive statistics (mean and Standard Deviation) were calculated. Association of infants born to COVID-19 positive mothers with delay in immunization, Nutritional status and Immunization was analyzed by Chi- square test and p- value. Odds ratio were calculated with 95% Confidence interval and Chi Square test applied for association between the variables. The level of significance was 5%, confidence interval of 95% used to interpret statistical significance.


Identify all the deliveries that happened at Santosh medical hospital in COVID dedicated Labour rooms.
Consent was taken from the Attendants of the child for enrolling in the study
Follow up of children born to COVID 19 positive mothers was done in OPD at Santosh Hospital.
On the 1st visit, detailed history of previous feeding, development history (as per ASQ 3 staging)and immunization records was documented along with weight charting and counselling were done.
Further records were documented at subsequent visits, at 6 and 12 months of age.

Observations

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Results

OBSERVATIONS AND RESULTS

102 COVID Positive pregnant women who were admitted in Santosh Medical college and Hospital, Ghaziabad, UP for delivery were identified and their newborns were followed up for Nutrition, Development and Immunization till 1 year of age. 102 women gave birth during the study period. Three infants died on the first day of life due to severe birth asphyxia, 83 completed follow-up and 16 infants were lost to follow-up. The main reason for the loss to follow-up was the inability to contact the parents due to either invalid contact number or unwillingness for follow-up.

Table 1. Mode of delivery of Infants born to Covid Positive Mothers Enrolled in the study.

Mode of delivery	Number	Percentage
NVD	34	41%
LSCS	49	59%
Total	83	

Figure 1. Mode of delivery of Infants born to Covid Positive Mothers Enrolled in the study.

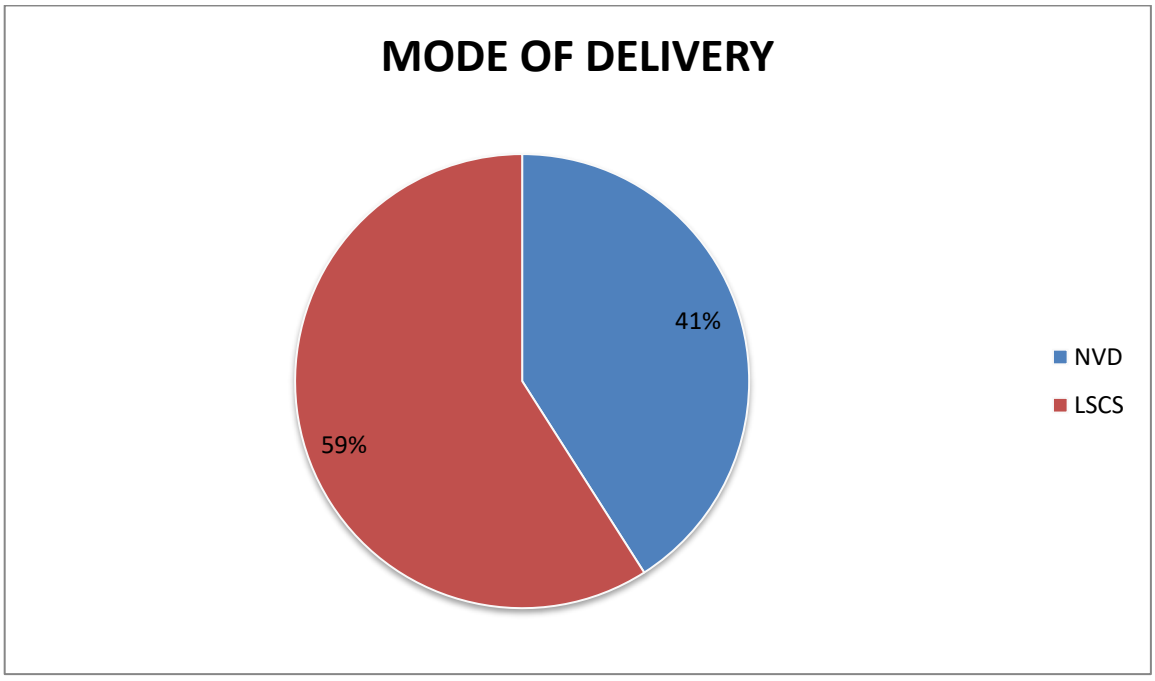


Table 1. Shows Mode of delivery of Covid Positive Mothers Enrolled in the study were 41% via NVD (n=34) and 59% via LSCS (n=49)

Table 2. Gestational age of infants born to COVID 19 Positive Mothers Enrolled in the study.

Gestational age	Number	Percentage
Preterm	16	19%
Term	67	81%
Total	83	

Figure 2. Gestational age of Infants born to COVID 19 Positive Mothers Enrolled in the study.

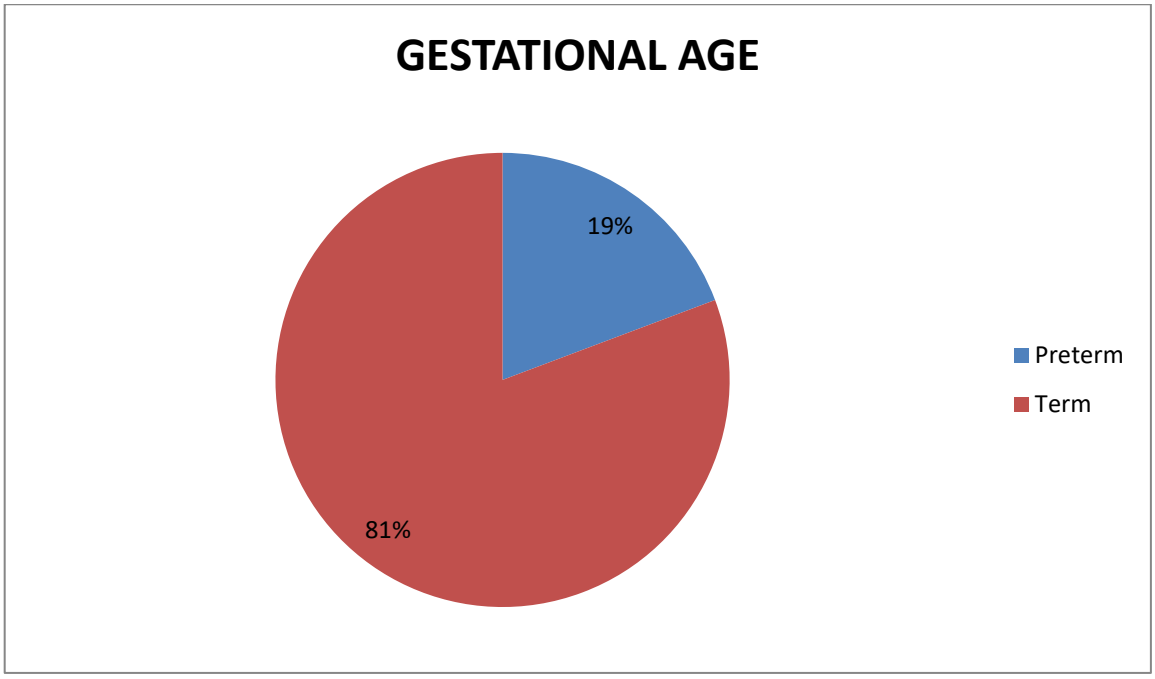


Table 2. Shows 81% were Term deliveries (n=67) and 19 % were Preterm Deliveries (n=16).

Table 3. Sex ratio of Infants born to COVID 19 Positive Mothers Enrolled in the study.

Sex	Number	Percentage
Male	45	54%
Female	38	46%
Total	83	

Figure 3. Sex ratio of Infants born to COVID 19 Positive Mothers Enrolled in the study.

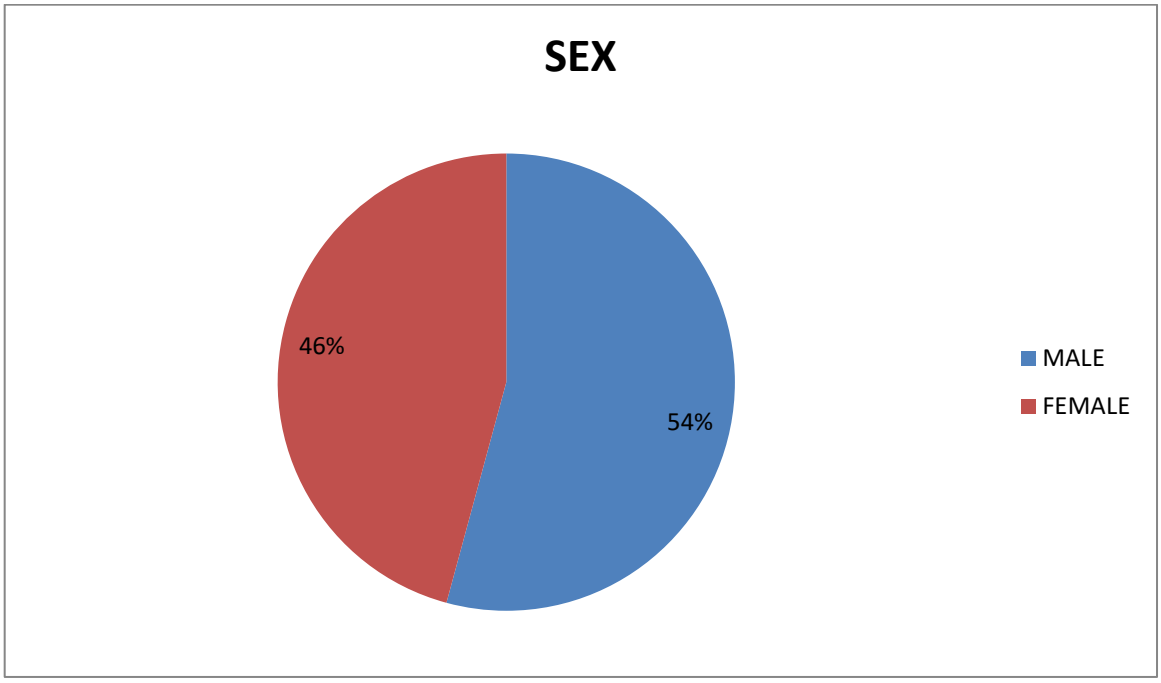


Table 3. Shows 54% were Males (n=45) and 46 % were females(n=38).

Table 4. APGAR score at 1 minute of life of infants born to COVID 19 Positive Mothers Enrolled in the study.

APGAR SCORE @ 1 Min	Number	Percentage
<4	0	0%
4-7	78	94%
>7	5	6%
Total	83	

Figure 4. APGAR score at 1 minute of life of infants born to COVID 19 Positive Mothers Enrolled in the study.

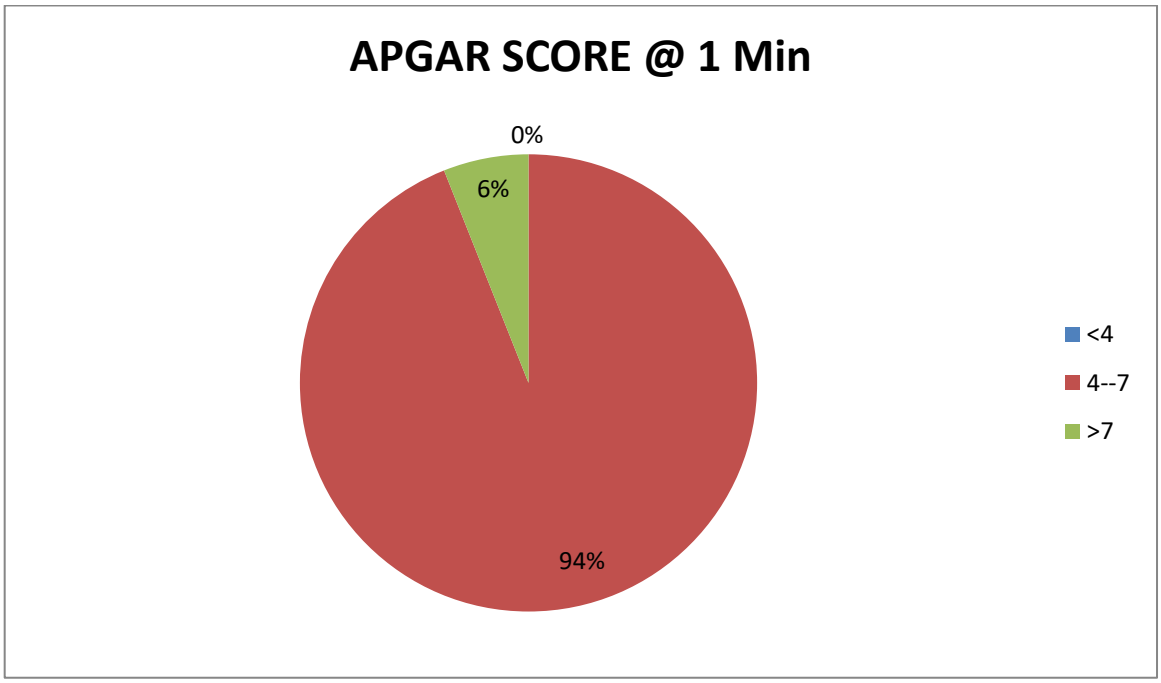


Table 4. Shows 0% had an APGAR score of <4, 94% had an APGAR score of 4-7 (n=78), 6% had an APGAR score of >7 (n=5).

Table 5. APGAR score at 5 minute of life of infants born to COVID 19 Positive Mothers Enrolled in the study.

APGAR SCORE @ 5 Min	Number	Percentage
<4	0	0%
4-7	3	4%
>7	80	96%
Total	83	

Figure 5. APGAR score at 5 minute of life of infants born to Covid Positive Mothers Enrolled in the study.

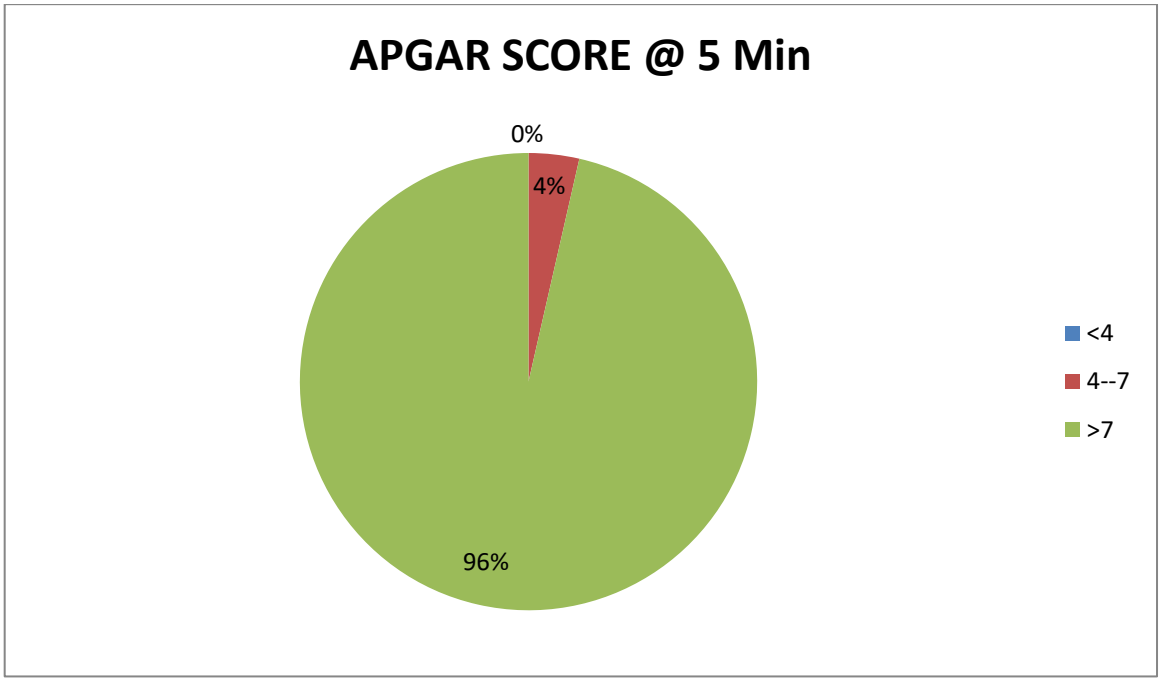


Table 5. Shows 0% had an APGAR score of <4, 4% had an APGAR score of 4-7 (n=3), 96% had an APGAR score of >7 (n=81).

Table 6. Gravida status of Covid Positive Mothers Enrolled in the study.

Gravida	Number	Percentage
Primi	36	44%
Gravida 2	24	28%
Gravida 3	16	19%
Gravida 4	4	5%
Gravida 5	3	4%
Total	83	

Figure 6. Gravida status of Covid Positive Mothers Enrolled in the study.

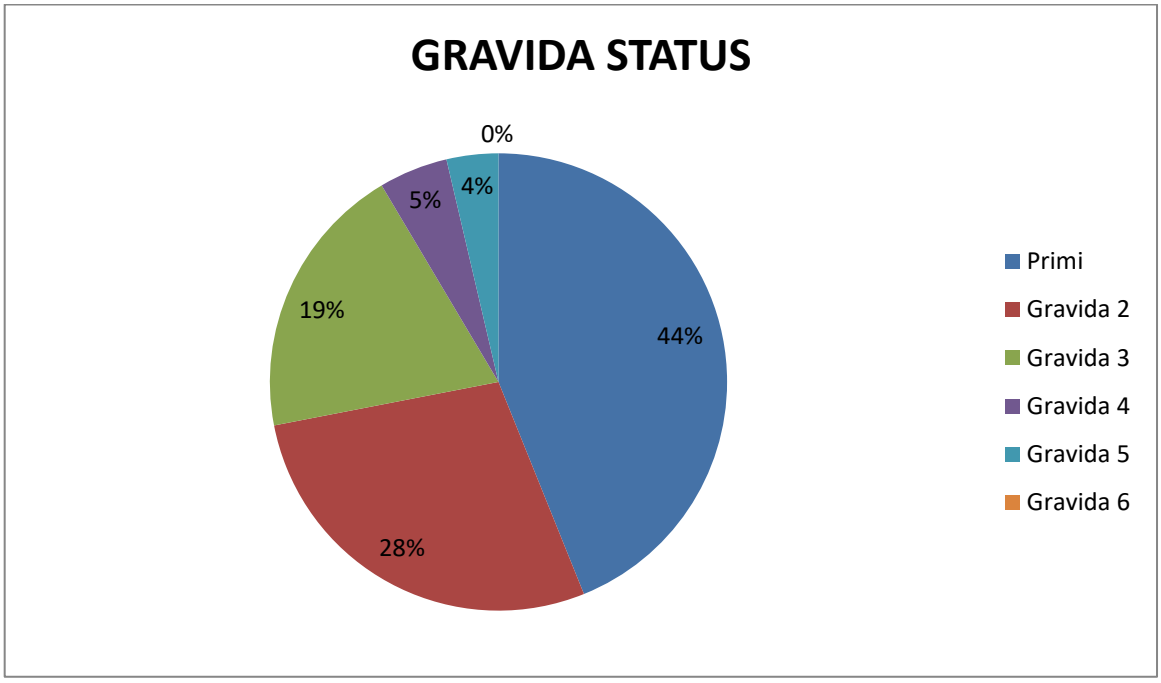


Table 6. Shows 44% (n=36) were Primi Gravida, 28% (n=24) were Gravida 2, 19% (n=16) were Gravida 3, 5% (n=4) were Gravida 4, 4% (n=3) were Gravida 5, None were Gravida 6.

Table 7. Delayed cry at birth in infants born to Covid Positive Mothers Enrolled in the study.

Delayed cry at birth	Number	Percentage
Yes	6	7%
No	77	93%
Total	83	

Figure 7. Delayed cry at birth in infants born to Covid Positive Mothers Enrolled in the study.

Table 7. Shows 93% (n=77) had no delay in cry at Birth, 7% (n=6) had delay in cry at birth.

Table 8. Outcome of babies born to Covid Positive Mothers Enrolled in the study.

Outcome of babies	Number	Percentage
Handed over and sent home	68	82%
NICU admission	15	18%
Total	83	

Figure 8. Outcome of born to Covid Positive Mothers Enrolled in the study.

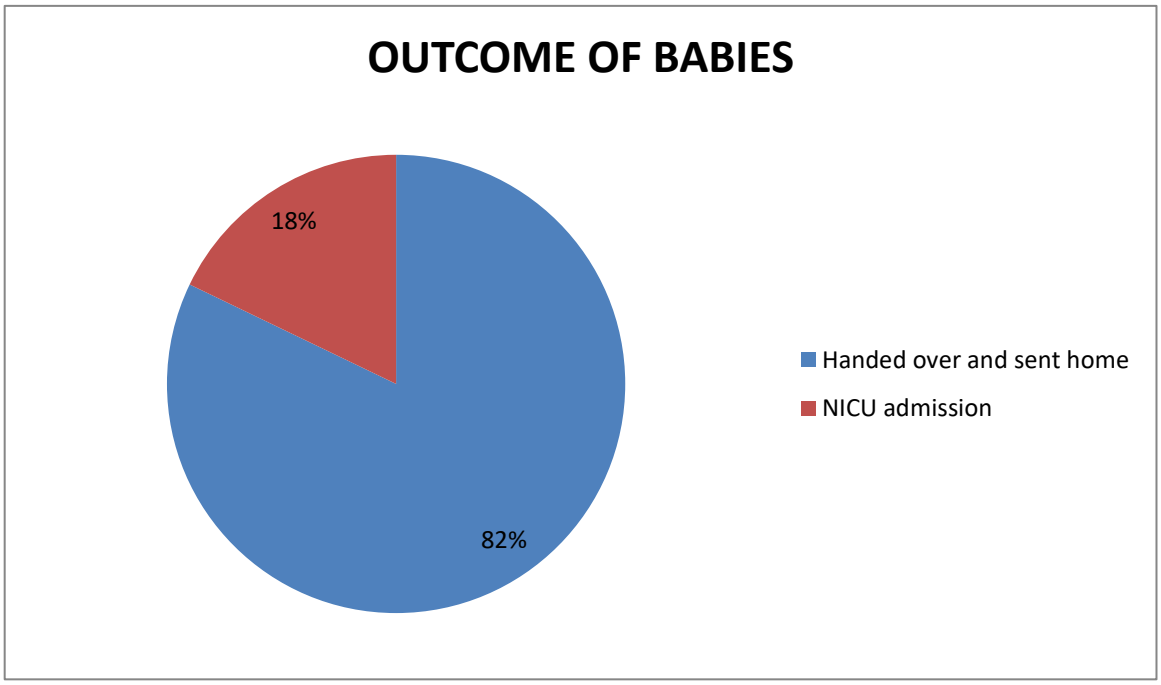


Table 8. Shows 82% (n=68) were Handed over and sent home, 18% (n=15) required NICU admission.

Table 9. Reason for NICU admission of babies born to Covid Positive Mothers Enrolled in the study.

Reason for NICU admission	Number	Percentage
RDS at birth	13	87%
Icterus	2	13%
Total	15	

Figure 9. Reason for NICU admission of babies born to Covid Positive Mothers Enrolled in the study.

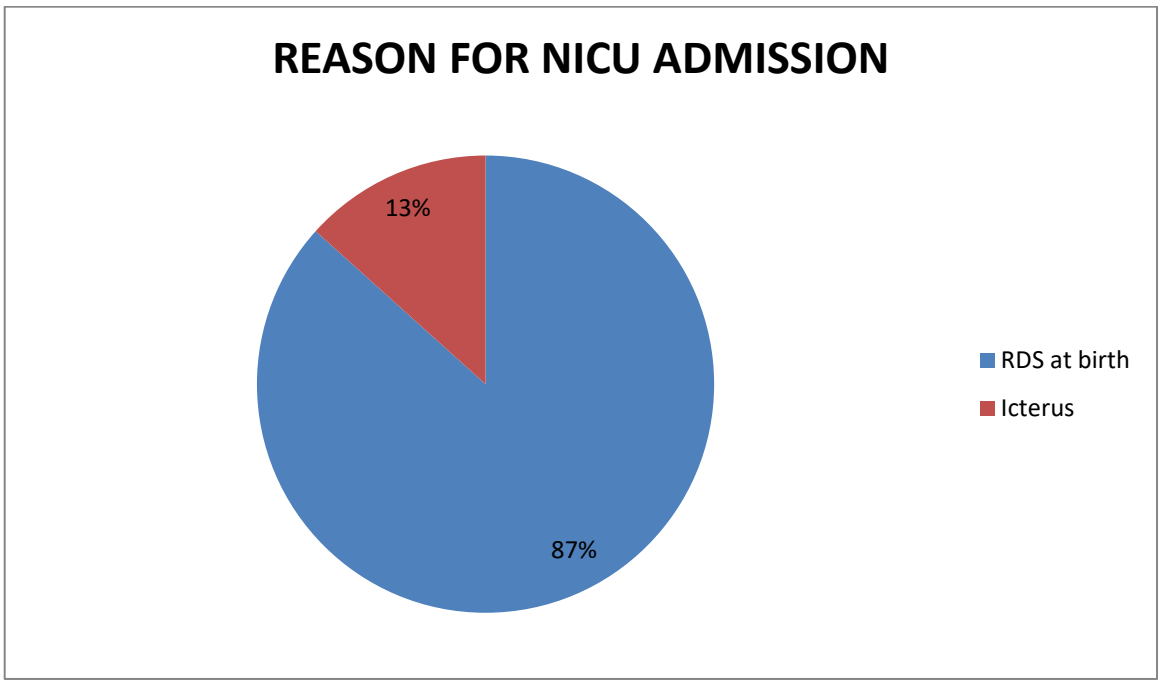


Table 9. Shows Out of 15 infants requiring NICU admission, 13% (n=2) developed Icterus and 87% (n=13) had Respiratory distress at birth.

Table 10. Birth weight of babies born to Covid Positive Mothers Enrolled in the study.

Birth weight	Number	Percentage
<1 Kg(ELBW)	0	Nil
1-1.49 Kg(VLBW)	1	70%
1.5-2.49 Kg(LBW)	24	29%
2.5-3.9 kg	58	1%
>4kg	0	Nil
Total	83	

Figure 10. Birth weight of babies born to Covid Positive Mothers Enrolled in the study.

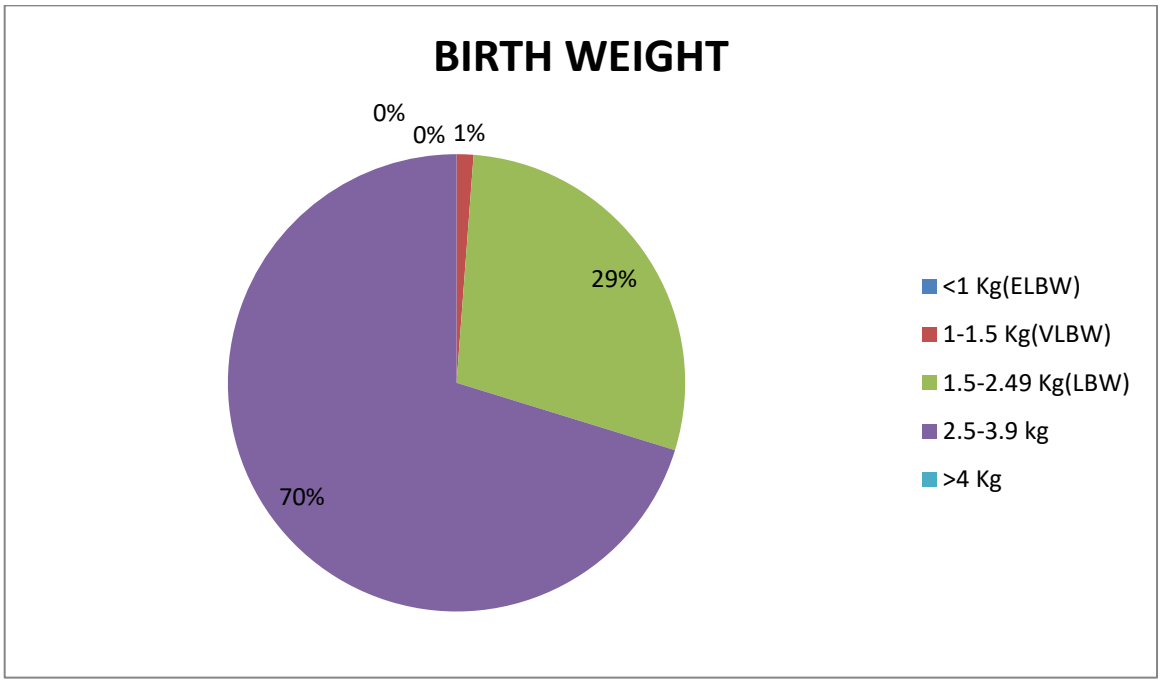


Table 10. Suggests 70% (n=58) infants weighed 2.5-3.9 kg, 29% (n=24) were 1.5 2.49kg, 1% (n=1) weighed 1-1.49kg, none of the babies weighed <1kg or more than 4 kg.

Table 11. Weight at 6 months of age of babies born to Covid Positive Mothers Enrolled in the study.

Weight at 6 months	Males (number)	Males (Percentage)	Females (Number)	Females (Percentage)
< -3 SD	5	11%	9	24%
-3 SD to -2SD	5	11%	5	13%
-2SD to -1SD	7	15%	5	13%
-1SD to Mean	15	34%	9	24%
Mean to +1SD	7	15%	6	16%
+1SD to +3 SD	3	7%	3	7%
+2SD to +3SD	3	7%	1	3%
+3 SD	0	nil	0	Nil
Total	45		38	

Figure 11. Weight at 6 months of age of babies born to Covid Positive Mothers Enrolled in the study

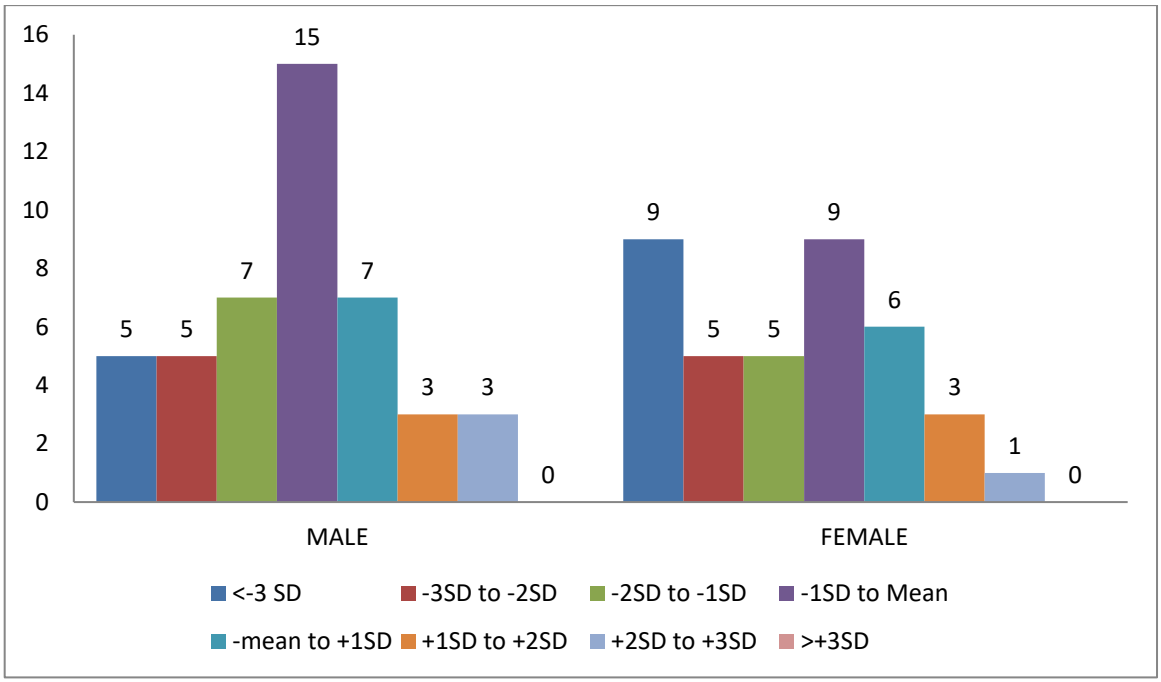


Table 11. Out of n=45 Males, 11% (n=5) were <-3 SD, 11% (n=5)were between -3SD to -2SD, 15% (n=7)were between -2SD to -1SD, 34% (n=15)were between -1SD to Mean, 15% (n=7) were between Mean and +1SD, 7% (n=3)were between 1SD to 2SD, 7% (n=3)were between 2SD to 3SD, None were >3 SD .

Out of n=38 Females, 24% (n=9) were <-3 SD, 13% (n=5)were between -3SD to -2SD, 13% (n=5)were between -2SD to -1SD, 24% (n=9)were between -1SD to Mean, 16% (n=6) were between Mean and +1SD, 7% (n=3)were between 1SD to 2SD, 3% (n=1)were between 2SD to 3SD, None were >3 SD .

Table 12. Weight at 12 months of age of babies born to Covid Positive Mothers Enrolled in the study.

Weight at 6 months	Males (number)	Males (Percentage)	Females (Number)	Females (Percentage)
< -3 SD	3	7%	3	8%
-3 SD to -2SD	5	11%	5	13%
-2SD to -1SD	7	15%	10	26%
-1SD to Mean	15	34%	9	24%
Mean to +1SD	9	20%	6	16%
+1SD to +2 SD	3	7%	3	8%
+2SD to +3SD	3	7%	2	5%
+3 SD	0	nil	0	Nil
Total	45		38	

Figure 12. Weight at 12 months of age of babies born to Covid Positive Mothers Enrolled in the study.

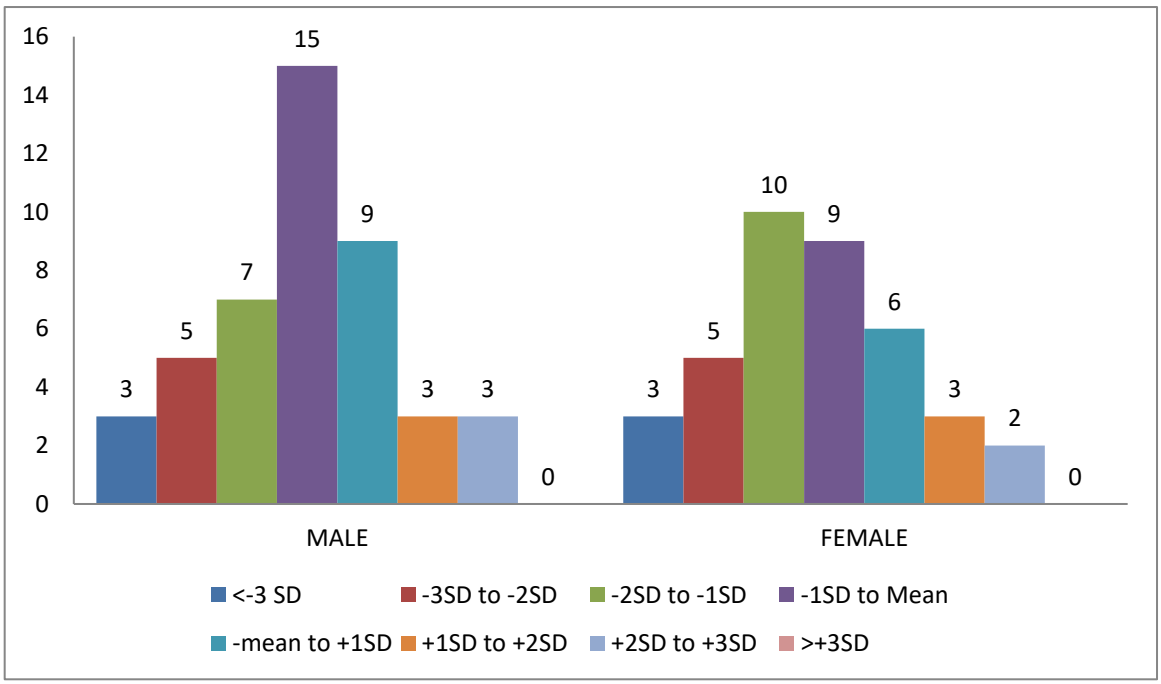


Table 12. Out of n=45 Males, 7% (n=3) were <-3 SD, 11% (n=5)were between -3SD to -2SD, 15% (n=7)were between -2SD to -1SD, 34% (n=15)were between -1SD to Mean, 20% (n=9) were between Mean and +1SD, 7% (n=3)were between 1SD to 2SD, 7% (n=3)were between 2SD to 3SD, None were >3 SD .

Out of n=38 Females, 8% (n=3) were <-3 SD, 13% (n=5)were between -3SD to -2SD, 26% (n=10)were between -2SD to -1SD, 24% (n=16)were between -1SD to Mean, 8% (n=3) were between Mean and +1SD, 8% (n=3)were between 1SD to 2SD, 5% (n=2)were between 2SD to 3SD, None were >3 SD .

NUTRITIONAL STATUS

Table 13. Feeding practices for first 6 months of babies born to Covid Positive Mothers Enrolled in the study.

Feeding for first 6 months	Number	Percentage
Exclusive breastfeeding	24	29%
Formula feeding/Animal Milk	26	31%
Mixed Feeding(Breastfeeding + Formula/Animal Milk)	33	40%
Total	83	

Figure 13. Feeding practices for first 6 months of babies born to Covid Positive Mothers Enrolled in the study.

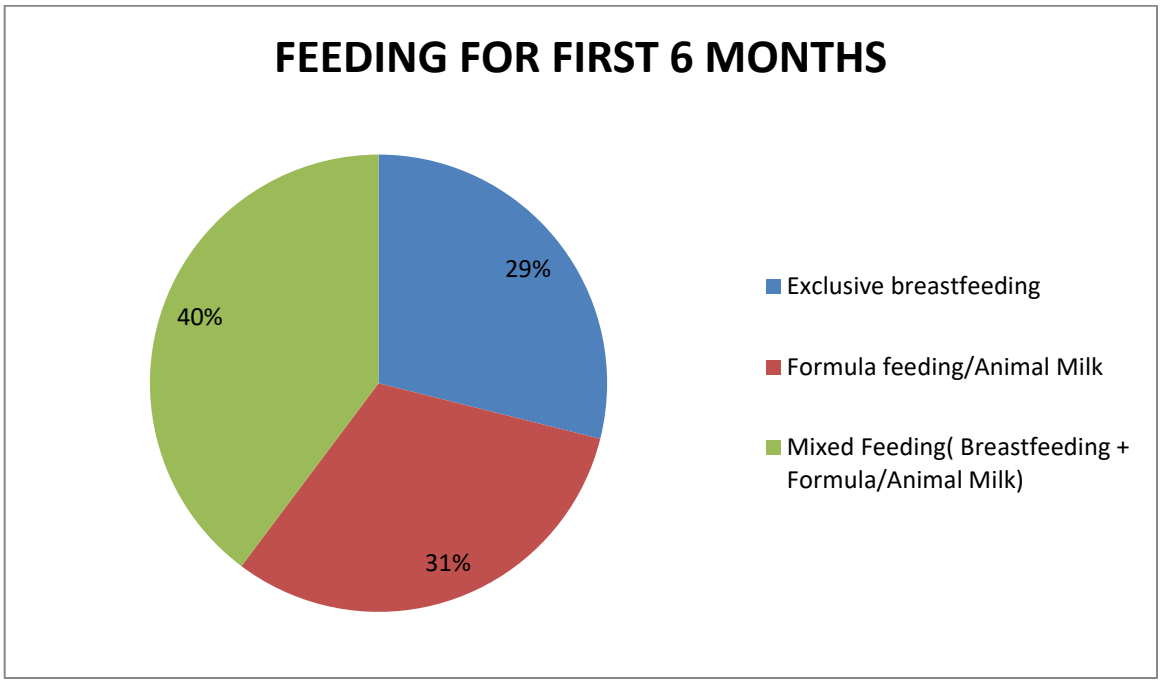


Table 13. Suggests 29% (n=24) preferred exclusive breast feeding, 31% (n=26) preferred formula feeds or animal feeds, 40% (n=33) preferred Mixed feeds.

Table 14. Feeding practices for 6-12 months of babies born to Covid Positive Mothers Enrolled in the study.

Feeding for 6 - 12 months	Number	Percentage
Exclusive Breast feeding continued	7	8%
Breast feeding along with complementary feeds started at 6 months	52	63%
Breast feeding along with complementary feeding started at 9 months	24	29%
Total	83	

Figure 14. Feeding practices for first 6 months of babies born to Covid Positive Mothers Enrolled in the study.

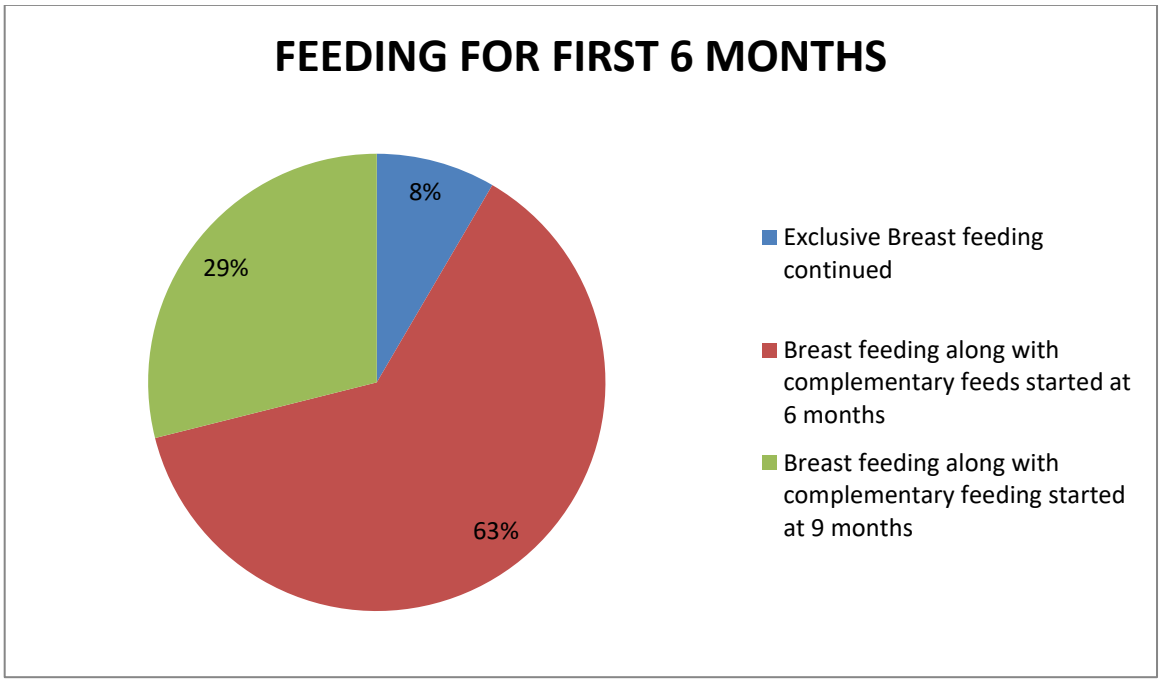

FEEDING FOR FIRST 6 MONTHS
8%
29%
63%
Exclusive Breast feeding continued
Breast feeding along with complementary feeds started at 6 months
Breast feeding along with complementary feeding started at 9 months

Table 14. Suggests 8% (n=7) didn't start complementary feeds and continued exclusive breast feeding, 29% (n=24) started complementary feeds at 9 months of age, 63% (n=52) started complementary feeds at 9 months of age.

Table 15. Nutritional variation Present study v/s Reference Pre Covid study

Variable	Present study (n)	(%)	Reference Pre Covid (n)	(%)
Exclusive breast feeding done	24	29%	96	77%
Exclusive breast feeding not done	59	71%	28	23%
Complementary feeding initiated after 6 months	76	92%	90	97%
Complementary feeding not initiated	7	8%	3	3%

Figure. 15. **Nutritional variation Present study v/s Reference Pre Covid study**

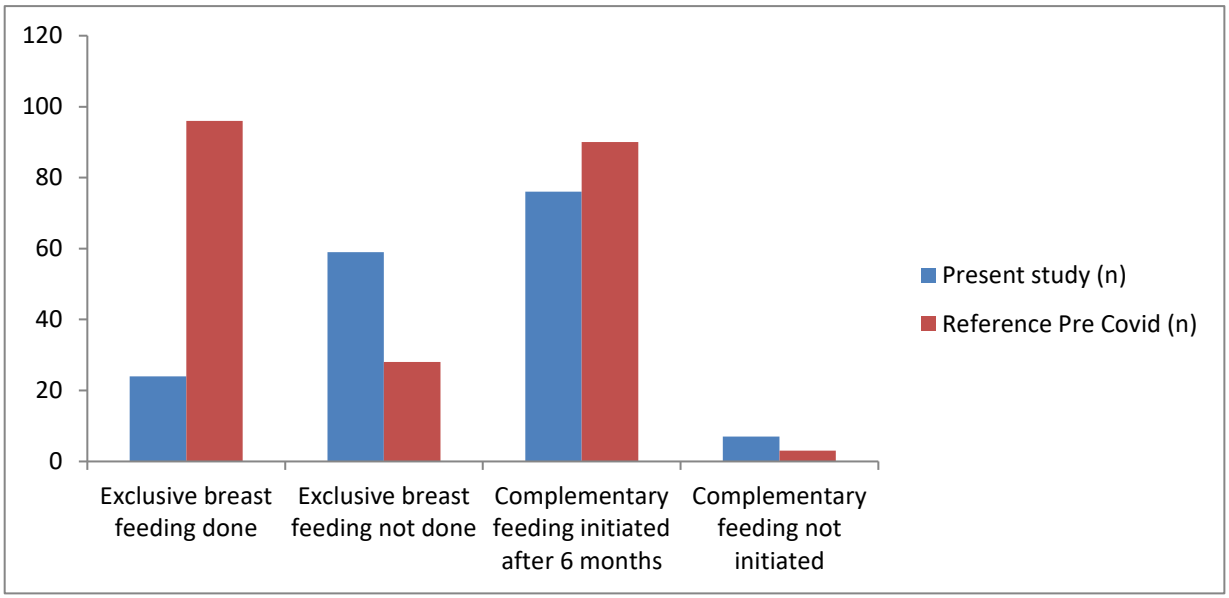


Table 15. Suggests 29% (n=24) were exclusively breast fed in present study, whereas, 77% (n=96) were exclusively breast fed in reference pre COVID study. 71% (n=59) were not exclusively breast fed in present study, whereas, 23% (n=28) were not exclusively breast fed in reference pre COVID study. Complementary feeding was initiated after 6 months in 92% (n=76) infants in our study, where as 97% (n=90) were given complementary feeding after 6 months in reference Pre COVID study. Complementary feeding was not initiated after 6 months in 8% (n=7) infants in our study, where as 3% (n=3) were not given complementary feeding after 6 months in reference Pre COVID study.

Table 16. Association of Exclusive Breastfeeding at 6 Months in infants born to mother with COVID-19 positive RTPCR compared to pre COVID period.

VARIABLE	Number of Participants	Exclusive breast feeding done	Exclusive breast feeding not done	χ^2	p-value	ODDS RATIO	95% CI
Reference Pre COVID study	123	95	28	47.42	**0.0001**	8.34	4.4-15.7
Present study	83	24	59				

Feeding in the First Six Months

About 24 (28.9%) children were reported to be exclusively breastfed for initial 6 months, and 26 (31.3%) preferred animal milk/ formula feed, 33 (39.7%) mixed feeds. In comparison to Historical Cohort where 77.2% were exclusively breast fed and 22.7% with animal milk/ top feed/ mixed feeds.

Association of Breastfeeding habits in children pre COVID and during COVID

There was significant change in breast feeding practices before COVID and during COVID period (77.2% v/s 28.9%, p-value: <0.0001) with OR: 8.34 and 95% CI of 4.4-15.7 making it extremely statistically significant. Detailed data provided in Table 16.

Table 17. Association of complementary feeding at >6 Months in infants born to mother with COVID-19 positive RTPCR compared to pre COVID period.

Variable	Individuals	Initiation of complementary feeds done	Initiation of complementary feeds not done	X^2	P-value	Odds ratio	95% CI
Reference Pre COVID study	93	90	3				
Present Study	83	76	7	3.6	0.05	3.64	0.95-13.96

Initiation of complementary feeds

About 91.5% (n=76) initiated complementary feeds at 6 months, 8.4% (n=7) did not initiate proper complementary feeds or gave minimal complementary feeds at 6 months.

Association of Complementary feeding habits in children pre COVID and during COVID

There was no significant change in complementary feeding practices before COVID and during COVID period (96.7% v/s 91.5%, p-value: 0.05) with OR: 3.64 and 95% CI of 0.95-13.96 making it statistically insignificant. Detailed data provided in Table 17.

VACCINATION

Table 18. Birth vaccination status of babies born to Covid Positive Mothers Enrolled in the study.

Birth vaccination	Number	Percentage
Not done	10	12%
At birth	13	16%
Within 7 days	18	22%
Within 14 days	20	24%
Within 1 month	14	17%
>1 month	8	10%
Total	83	

Figure 16. Birth vaccination status of babies born to Covid Positive Mothers Enrolled in the study.

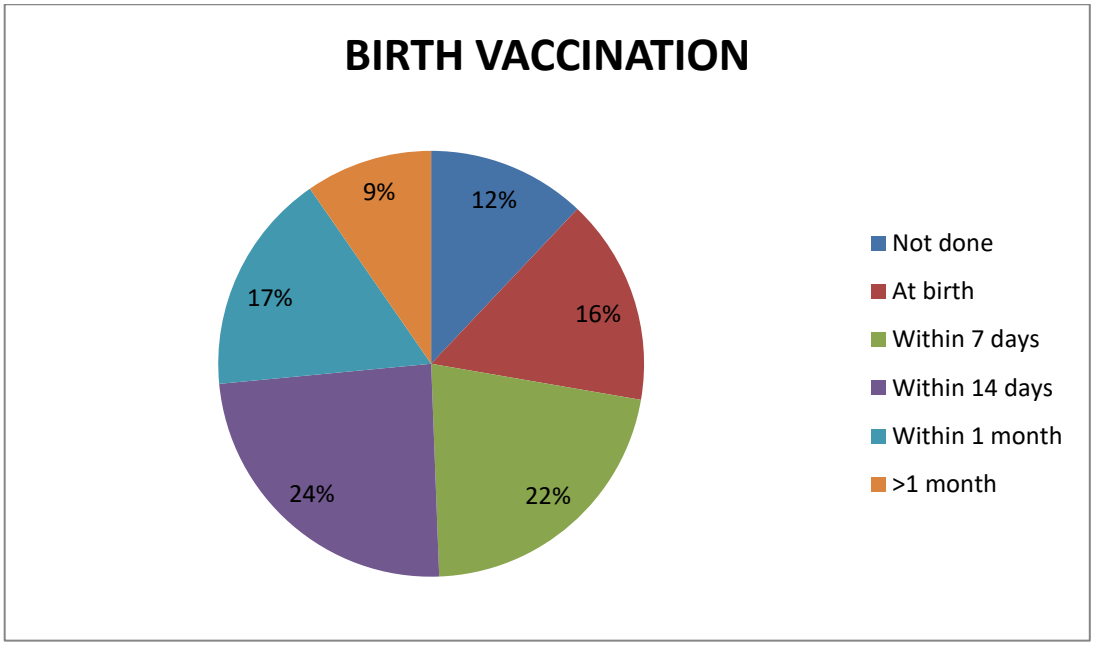


Table 18 shows of the 83 consecutively-admitted children, aged 0-12 months only 13 (16%) were fully immunized, 60 (72.3%) were partially immunized, and 10 (12%) were non-immunized. Partially and non immunized children were categorized as delay in immunization.

Table 19. Variation in Routine Childhood Immunization present study.

Variable	Number of Participants	No delay in immunization	Delay in immunization
Birth order			
<2	36	7	29
>2	47	6	41
Sex			
Male	45	9	36
Female	38	4	34
Mode of delivery			
Vaginal	34	6	28
Lscs	49	7	42

Of the fully immunized children 9 (69.2%) were males and 4 (30.7%)were females. 36 (51.4%) males and 34 (48.5%) females had delay in immunization. Amongst Vaginally delivered children 6 (17.6%) had no delay in immunization and 28 (82.3%) had delay in immunization. Amongst children delivered by LSCS 7 (14.2%) had no delay in immunization and 42 (85.7%) had delay in immunization. Detailed reference in Table 19.

Table 20. Variation in Routine Childhood Immunization reference pre COVID study.

Variable	Number of participants	No delay in immunization	Delay in immunization
Birth order			
<2	104	52	52
>2	65	6	59
Sex			
Male	90	51	39
Female	79	7	72
Mode of delivery			
Vaginal	97	6	91
Lscs	72	52	20

Of the fully immunized children 51 (87%) were males and 7 (12%)were females. 39 (35%) males and (64.8%) females had delay in immunization. Amongst Vaginally delivered children 6 (10.3%) had no delay in immunization and 91(81.1%) had delay in immunization. Amongst children delivered by LSCS 52 (89.6%) had no delay in immunization and 20 (18%) had delay in immunization. Detailed reference in Table 20.

Table 21. Association of delay in Immunization with respect to sex in infants born to mother with COVID-19 positive RTPCR compared to pre COVID period.

VARIABLE	**Number of Participants**	NO DELAY IN IMMUNIZATION	DELAY IN IMMUNIZATION	X2	P-VALUE	ODDS RATIO	95% CI
SEX							
MALE (reference Pre COVID Study)	90	51	39	16.335	**0.0001**	5.23	2.2-12.12
MALE (Present study)	45	9	36				
FEMALE (reference Pre COVID Study)	79	7	72	0.084	0.77	0.8	0.22-3.01
FEMALE (Present study)	38	4	34				

Association of sex with delay in Routine childhood Immunization during COVID

There was significant delay in routine childhood immunization in males before COVID and during COVID period (43.3% v/s 80%, p-value: =0.0001) with OR: 5.23 and 95% CI of 2.2-12.12 making it extremely statistically significant.

Whereas in females, no significant delay was obserbed before and during COVID. (91.1% v/s 89.4% , p- value : 0.77). Detailed data provided in Table 21.

Table 22. Association of delay in Immunization with respect to birth order in infants born to mother with COVID-19 positive RTPCR compared to pre COVID period.

Variable	Number of participants	No delay in immunization	Delay in immunization	X2	P-value	Odds ratio	95% ci
Birth order							
<2 (reference Pre COVID Study)	104	52	52	10.24	**0.0014**	4.14	1.66-10.29
<2 (Present study)	36	7	29				
>2 (reference Pre COVID Study)	65	6	59	0.35	0.55	0.6	0.20-2.3
>2 (present study)	47	6	41				

Association of birth order with delay in Routine childhood Immunization during COVID

There was significant delay in routine childhood immunization in children with <2 birth order before COVID and during COVID period (50% v/s 80%, p-value: <0.001) with OR: 4.14 and 95% CI of 1.66-10.29 making it statistically significant.

Whereas in children with >2 birth order, no significant delay was observed before and during COVID. (90.7% v/s 90.7% , p- value : 0.55). Detailed data provided in Table 22.

Table 23. Association of delay in Immunization with respect to mode of delivery in infants born to mother with COVID-19 positive RTPCR compared to pre COVID period.

VARIABLE	Number of Participants	NO DELAY IN IMMUNIZATION	DELAY IN IMMUNIZATION	X2	P-VALUE	ODDS RATIO	95% CI
MODE OF DELIVERY							
VAGINAL (reference Pre COVID Study)	97	6	91	3.974	**0.023**	0.3	0.09-1.03
VAGINAL (present study)	34	6	28				
LSCS (reference Pre COVID Study)	72	52	20	39.17	**0.0001**	3.42	1.4-8.1
LSCS (Present study)	49	7	42				

Association of mode of delivery with delay in Routine childhood Immunization during COVID

There was delay in routine childhood immunization in children born via NVD before COVID and during COVID period (93.8% v/s 82.3%, p-value: <0.05) with OR: 0.3 and 95% CI of 0.09-1.03 making it less statistically significant.

There was significant delay in routine childhood immunization in children born via LSCS before COVID and during COVID period (27.7% v/s 85.7%, p-value: <0.0001) with OR: 3.42 and 95% CI of 1.4-8.1 making it less statistically significant. Detailed data provided in Table 23.

DEVELOPMENT

Table. 24. ASQ-3 score at 6 months of age (communication)

ASQ-3 score at 6 months (communication)	
Below cutoff	2
Borderline	0
Above cutoff	82

TABLE. 25 ASQ-3 score at 6 months of age (gross motor)

ASQ-3 score at 6 months (gross motor	
Below cutoff	2
Borderline	0
Above cutoff	82

Table. 26 asq-3 score at 6 months of age (fine motor)

ASQ-3 score at 6 months (fine motor)	
Below cutoff	2
Borderline	5
Above cutoff	77

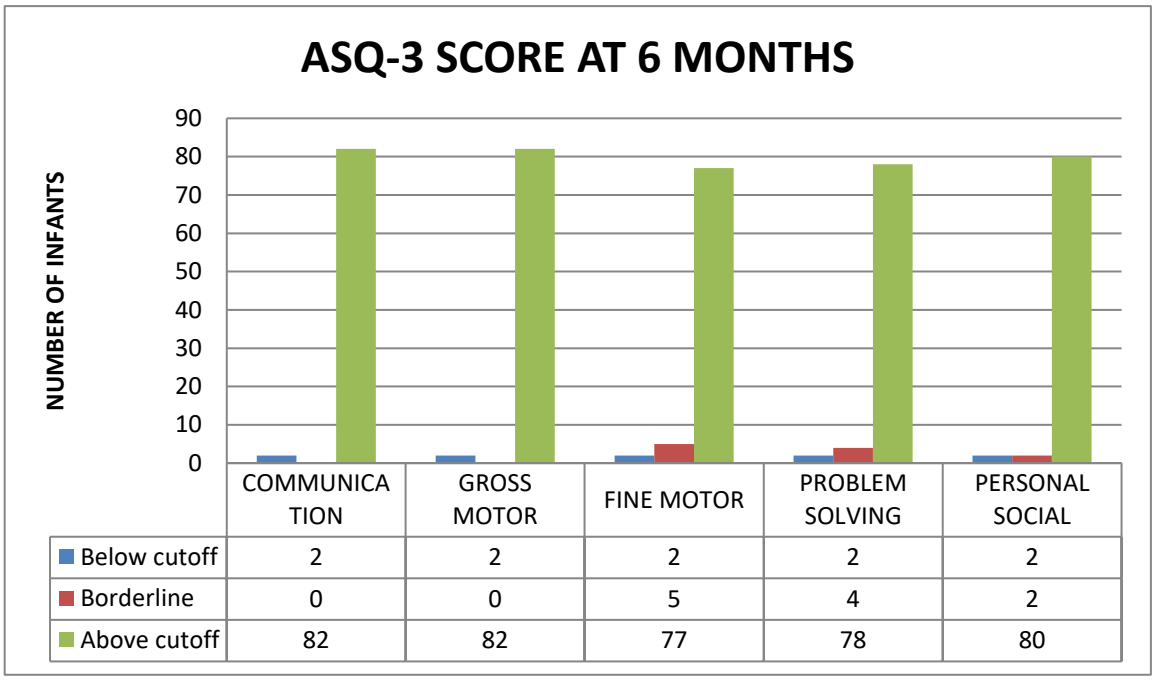
Table. 27 ASQ-3 score at 6 months of age (problem solving)

ASQ-3 score at 6 months (problem solving)	
Below cutoff	2
Borderline	4
Above cutoff	78

TABLE. 28 ASQ-3 score at 6 months of age (personal social)

ASQ-3 score at 6 months (personal social)	
Below cutoff	2
Borderline	2
Above cutoff	79

FIGURE. 17 ASQ-3 score at 6 months of age



	COMMUNICATION	GROSS MOTOR	FINE MOTOR	PROBLEM SOLVING	PERSONAL SOCIAL
Below cutoff	2	2	2	2	2
Borderline	0	0	5	4	2
Above cutoff	82	82	77	78	80

In current study, at 6 months of age, 2.4% (n=2) had an ASQ score below cutoff, zone and 97.5% (n=81) above cutoff (29.65) with respect to communication. 2.4% (n=2) had an ASQ score below cutoff, zone and 97.5% (n=81) above cutoff (22.25) with respect to gross motor skills. 2.4% (n=2) had an ASQ score below cutoff, zone and 97.5% (n=81) above cutoff (25.14) with respect to fine motor skills. 2.4% (n=2) had an ASQ score below cutoff, zone and 97.5% (n=81) above cutoff (27.72) with respect to problem solving. 2.4% (n=2) had an ASQ score below cutoff, zone and 97.5% (n=81) above cutoff (25.34) with respect to personal social development. Out of which 6.1% (n=5) lied in borderline development (above cutoff) with respect to fine motor development. 4.8% (n=4) lied in borderline development (above cutoff) with respect to problem solving. 2.4% (n=2) lied in borderline development (above cutoff) with respect to personal social domain.

TABLE. 29 ASQ-3 SCORE at 12 months of age (communication)

ASQ-3 score at 12 months (communication)	
Below cutoff	2
Borderline	2
Above cutoff	79

TABLE. 30 ASQ-3 score at 12 months of age (gross motor)

ASQ-3 score at 12 months (gross motor	
Below cutoff	2
Borderline	1
Above cutoff	80

TABLE. 31 ASQ-3 score at 12 months of age (fine motor)

ASQ-3 score at 12 months (fine motor)	
Below cutoff	3
Borderline	0
Above cutoff	80

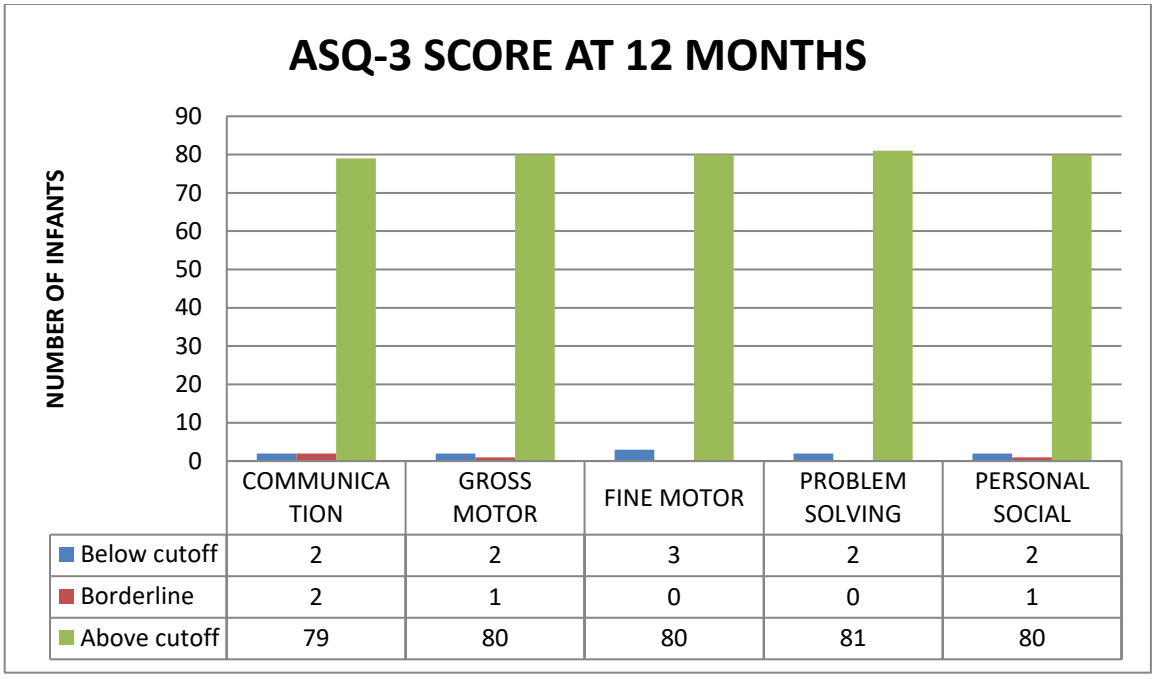
TABLE. 32 ASQ-3 score at 12 months of age (problem solving)

ASQ-3 score at 12 months (problem solving)	
Below cutoff	2
Borderline	0
Above cutoff	81

TABLE. 33 ASQ-3 SCORE at 12 months of age (personal social)

ASQ-3 score at 12 months (personal social)	
Below cutoff	2
Borderline	1
Above cutoff	80

FIGURE. 18 ASQ-3 score at 12 months of age



	COMMUNICATION	GROSS MOTOR	FINE MOTOR	PROBLEM SOLVING	PERSONAL SOCIAL
Below cutoff	2	2	3	2	2
Borderline	2	1	0	0	1
Above cutoff	79	80	80	81	80

At 12 months of age, 2.4% (n=2) had an ASQ score below cutoff, zone and 97.5% (n=81) above cutoff (29.65) with respect to communication. 2.4% (n=2) had an ASQ score below cutoff, zone and 97.5% (n=81) above cutoff (22.25) with respect to gross motor skills. 3.6% (n=3) had an ASQ score below cutoff, zone and 96.3% (n=80) above cutoff (25.14) with respect to fine motor skills. 2.4% (n=2) had an ASQ score below cutoff, zone and 97.5% (n=81) above cutoff (27.72) with respect to problem solving. 2.4% (n=2) had an ASQ score below cutoff, zone and 97.5% (n=81) above cutoff (25.34) with respect to personal social development. Out of which 2.4% (n=2) lied in borderline development (above cutoff) with respect to communication. 1.2% (n=1) lied in borderline development (above cutoff) with respect to gross motor development. 1.2% (n=1) lied in borderline development (above cutoff) with respect to personal social domain.

Table 34. Association of Gestational age to Delay in development in infants born to mother with COVID-19 positive RTPCR

Variable	Number of participants	No delay in development	Delay in development	X2	P-value
Gestation age					
Term	67	65	2	0.39	0.5
Preterm	16	15	1		

Association of Gestation age with delay in development in children born to COVID 19 positive mother.

There was no significant delay in development in children born to different gestational ages during COVID period (p-value: 0.5, $\chi 2 = 0.32$) making it statistically insignificant. Detailed data provided in Table 34.

Table35. Association of birth weight to Delay in development in infants born to mother with COVID-19 positive RTPCR

Variable	Number of participants	No delay in development	Delay in development	Chi	P value
Birth weight					
>2.5kg	58	56	2	0.025	0.87
Low birth weight	24	23	1		
Very low birth weight	1	1	0		
Extremely low birth weight	0	0	0		

Association of birth weight with delay in development in children born to COVID 19 positive mother.

There was no significant delay in development in children with different birth weights during COVID period (p-value: 0.87, $\chi 2 = 0.025$) making it statistically insignificant. Detailed data provided in Table 35.

Table 36. Association of delay in cry to Delay in development in infants born to mother with COVID-19 positive RTPCR

Variable	Number of participants	No delay in development	Delay in development	Chi	P value
CIAB					
Yes	77	76	1	16.39	**0.0001**
No	6	4	2		

Association of delayed cry at birth with delay in development in children born to COVID 19 positive mother.

There was significant delay in development in children with delay in cry during COVID period (p-value: 0.0001, $\chi 2 = 16.32$) making it statistically insignificant. Detailed data provided in Table 36.

Discussion

DISCUSSION

The present prospective observational study was conducted in the Department of Pediatrics in Santosh Medical college and Hospital, Ghaziabad, Uttar Pradesh to study the effect of COVID 19 on infants born to mothers with RTPCR positive COVID 19 infection with respect to their Nutritional, Developmental and Immunization status. The infants born to COVID RTPCR positive mothers in Santosh Medical college and hospital were enrolled in the study. 83 infants were enrolled for the study following the inclusion and exclusion criteria.

Maternal history (gestational age, gravid, antenatal history, symptoms for COVID 19, mode of delivery) was recorded in all inborn neonates including the Birth weight, APGAR score, Sex of baby, cry at birth, condition of child while handing over the child to attendants. During follow up, development (communication, gross motor, fine motor, personal social and problem solving), feeding pattern, immunization status, gain in weight at 6 months and 12 months were noted.

This study was a pioneer study in India so not much comparisons were available.

Mean weight at birth was 2.87kg, mean weight at 6 months was 5.67kg, mean weight at 12 months was 8.47kg, mean APGAR score at 1 min was 6.57, mean APGAR score at 5 min was 8.56.

11% males (n=5) and 23% females (n=9) had weight for age <-3 SD at 6 Months of age and 4.4% males (n=2) and 0% females had weight for age <-3 SD at 12 Months of age.

DEVELOPMENT

The fetal inflammatory response (FIRS) due to a maternal SARS-CoV-2 infection can contribute to severe neonatal morbidity, which includes stillbirth, neonatal death, preterm birth, low birth weight, fetal distress, and neonatal asphyxia. (36) This study reported neurological assessments of neonates born to mothers with SARS-CoV-2-positive RT–PCR test results during pregnancy using the ASQ-3. The findings of this study indicate that infants born to mothers who test positive for SARS-CoV-2 infection during pregnancy need to be assessed for neurodevelopmental delays. To assess the

developmental attainment of infants born to mothers with SARS-CoV-2-positive test results during pregnancy, ASQ-3, a screening tool is employed in this study for assessing the developmental attainment of young childrenand infants. (32)This screening tool is used widely in assessing development in children aged 1–66 months at a low cost, with cutoff scores identifying developmental delays. Percentages of infants screening beneath cutoff levels indicative of delays as per ASQ-3 developers. In the current study, ASQ-3 questionnaires were used, 97% (n=81) of the neonates at the end of 12 months showed normal developmental attainment, and only 3% (n = 2) showed developmental delays. Numerous investigators have studied the effects of several viral infections, excluding SARS-CoV-2, on pregnancy and fetal/neonatal outcomes and have reported thatvaricella-zoster, hepatitis C, maternal influenza, and other viruses produce discrete fetal brain structures and anatomical clinical pathologies of variable severities (37)(38). In our study, the incidence of infants with developmental delays was 3%. Compared with a previous study conducted in a similar geographical and cultural setting to India that used the same ASQ-3 screening tool with healthy children, the prevalence of developmental delays was 10%.(34)The difference could be explained by our smaller collected sample size or could indeed be because the risk of developmental delays among infants born to SARS-CoV-2-infected mothers is not diverse than that in the general population.

In both studies, neurological outcomes were assessed in early infancy, an approach that could miss later neurodevelopmental delays. In our study, we evaluated the infantsneurobehavioral development 12 months post-discharge, which is perhaps the adequate duration for effects to appear. In our study data all of the pregnant women had a SARS-CoV-2 infection during their third trimester.

However, SARS-CoV-2 infection surges the chances of fetal distress, leading to high incidences of admission to the NICU.(39) Similar to other reported studies, in the current study, 14 out of the 83 (16.8%) neonates born to mothers with SARS-CoV-2 infections during pregnancy required NICU admission.(34) However, a systematic review reported that approximately 95% of the neonates born to mothers with SARS-CoV-2 infections during pregnancy were born in good condition. (40)

The FIRS, due to increased IL-6 levels following a maternal SARS-CoV-2 infection (41), may induce a wide range of adverse neurodevelopmental squeal, such as autism,

psychosis, and neurosensory deficits, later in life, similar to certain bacterial infections. (42)However, long-term longitudinal studies are required to validate these associations.

Due to small number of children and all children being from Ghaziabad, the study is not able to find out how many of newborns born to COVID 19 positive mothers actually developed delay. In the study developmentally delayed children born to COVID 19 positive mothers were not compared with children born to COVID 19 Negative mothers, thus the score should be interpreted with care.

NUTRITION

Dietary history from birth to 6 months and 6 months to 12 months was taken from attendants of all 83 infants. Counselling for exclusive breast feeding and initiation of complementary feeds at 6 months of age was done. The results were compared to a historical cohort performed in Uttar Pradesh.(43) In our study n=24 (28.9%) children were reported to be exclusively breastfed for initial 6 months, and n=26 (31.3%) preferred animal milk/ formula feed, 33 (39.7%) mixed feeds. In comparison to Historical Cohort where 77.2% were exclusively breast fed and 22.7% with animal milk/ top feed/ mixed feeds. Breast feeding practices before COVID and during COVID period (77.2% v/s 28.9%, p-value: <0.0001 with OR: 8.34 and 95% CI of 4.4-15.7 making it extremely statistically significant concluding breast feeding was significantly affected due to COVID 19 pandemic. Delay in breast feeding/ inadequate breastfeeding/ poor let down of breast milk could be associated with mandatory quarantine of COVID 19 mothers for 14 days, extra cautiousness of the attendants towards newborn further negating contact between mother and child, stressful environment for the mother causing poor milk let down etc

91 .5% (n=76) initiated complementary feeds at 6 months, 8.4% (n=7) did not initiate proper complementary feeds or gave minimal complementary feeds at 6 months. There was no significant change in complementary feeding practices before COVID and during COVID period (96.7% v/s 91.5%, p-value: 0.05) with OR: 3.64 and 95% CI of 0.95-13.96 making it statistically insignificant. This could be attributed to poor knowledge and awareness amongst the population in general.

Similar study on breast feeding practices during COVID 19 by Lau C Et al. in Pune, Maharashtra that those who tested positive for COVID-19 were more likely to cease EBF early. Testing positive for the virus was found to increase the chances of bottle feeds

whereas those who tested negative fed their babies directly at the breast. Mothers perceived breastfeeding as a possible mode of transmission of the virus and hence may have resulted in early termination of EBF. They concluded moderate stress and testing positive for COVID–19 were significantly negatively associated with EBF (P<0.001). (44)

IMMUNIZATION

Of (n=83) aged 0-12 months only n=13 (16%) werefully immunized, n=60 (72.3%) were partially immunized, and n=10 (12%) were non-immunized. Partially and non-immunized children were categorized as delay in immunization. Of the fully immunized children n=9 (69.2%) were males and n=4 (30.7%)were females. N=36 (51.4%) males and n=34 (48.5%) females had delay in immunization. Amongst Vaginally delivered children n=6 (17.6%) had no delay in immunization and n=28 (82.3%) had delay in immunization. Amongst children delivered by LSCS n=7 (14.2%) had no delay in immunization and n=42 (85.7%) had delay in immunization. A historical cohort from North India was taken to compare the results. (45)

In our study there was significant delay in routine childhood immunization in males before COVID and during COVID period (43.3% v/s 80%, p-value: =0.0001) with OR: 5.23 and 95% CI of 2.2-12.12 making it extremely statistically significant. Whereas in females, no significant delay was observed before and during COVID. (91.1% v/s 89.4%, p- value: 0.77). Gender bias and inequity could be one of the leadingcauses of delay in vaccination.

There was significant delay in routine childhood immunization in children with <2 birth order before COVID and during COVID period (50% v/s 80%, p-value: <0.001) with OR: 4.14 and 95% CI of 1.66-10.29 making it statistically significant. Whereas in children with >2 birth order, no significant delay was observed before and during COVID. (90.7% v/s 90.7%, p- value: 0.55). Pertaining to prior knowledge with first child for need for vaccination.

There was delay in routine childhood immunization in children born via NVD before COVID and during COVID period (93.8% v/s 82.3%, p-value: <0.05) with OR: 0.3 and 95% CI of 0.09-1.03 making it less statistically significant. There was significant delay in routine childhood immunization in children born via LSCS before COVID and during COVID period (27.7% v/s 85.7%, p-value: <0.0001) with OR: 3.42 and 95% CI of 1.4-

8.1 making it less statistically significant. Both NVD and LSCS born neonates were separated from the mother, mother was under mandatory quarantine for 14 days, hence no significant difference in delay in immunization was observed within the two groups with respect to pre- COVID pandemic.

Our study is also supported by Khan Et al. on impact of COVID 19 Pandemic on childhood immunization in Tertiary health Centre concluded a significant delay in routine childhood immunization during the pandemic ($p<0.001$). (46)

Gaps in routine childhood immunization require immediate attention. Further failure in sustaining the vaccination services and weak catch-up plans can lead to the emergence of vaccine preventable diseases which may result in increased childhood morbidity and mortality. Guideline by Indian Academy of Pediatrics Advisory Committee on Vaccines and Immunization Practices and catch up vaccination need to be followed for the same. (47)(48)

Summary

&

Conclusion

SUMMARY & CONCLUSION

- The present study was conducted in the Department of Pediatrics, Santosh Medical College and Hospital, Ghaziabad, Uttar Pradesh on children who were born to COVID 19 positive mothers enrolled for delivery in Santosh Medical college and Hospital, Ghaziabad from a period ofJuly 2020 to July 2021. Iinformation was collected by follow-up on OPD basis. Various facts observed in the study were:

- Only 83 attendants of the infants gave consent to be a part of the study and came for follow up in this study time.

- All mothers who were tested COVID RTPCR positive were under mandatory 14days quarantine according to the government guidelines.

- 40.9% were delivered via NVD, 59.0% were delivered via LSCS.

- 19.2% were delivered preterm, 80.7% were Term deliveries.

- 44% were Primi gravida, 28% were gravid 2, 19% were gravid 3, 5% were gravid 4, 4% were gravid 5.

- Delayed cry at birth was seen in 72.2% and 92.7% cried immediately after birth.

- 82% were handed over to attendants and 18% were kept in NICU. In first 14 days, 17% were symptomatic at birth, 33% symptoms developed later and 50% remained symptomless.

- Maximum (94%) had an APGAR score of 4-7, 6% had an APGAR of >7 and none had below 4 at 1 minute of life. Maximum (86%) had an APGAR score of >7, 4% had an APGAR of >4-7 and none had below 4-5 at 1 minute of life.

- Most Infants had birth weight between 2.5-3.9kg (70%), 29% weighed between 1.5-2.49kg (LBW) and 1% weighed 1-1.5kg (VLBV). None of the infants born were in the ELBW category or weighed more than 4kg.
- Of the infants born, 11% males and 23% females had weight for age <-3 SD at 6 Months of age and 4.4% males and 0% females had weight for age <-3 SD at 12 Months of age. Whereas, 88.8% males and 76.3% females had weight for age

between -3 SD and +3 SD at 6 months of age and 95.5% males and 100% females had weight for age between -3 SD and +3 SD at 12 months of age.

- About 28.9% children were reported to be exclusively breastfed for initial 6 months, and 31.3% preferred animal milk/ formula feed, 39.7% were given mixed feeds.

- In comparison to historic cohort there was a significant fall (p-value: <0.0001) in number of mothers opting for exclusive breast feeding.
- About 91.5% initiated complementary feeds at 6 months, 8.4% did not initiate proper complementary feeds or gave minimal complementary feeds at 6 months.
- In comparison to historic Cohort, there was no significant change in complementaryfeeding practices after the age of 6 months. (p-value: 0.05).
- Of the 83 subject infants, only 16% were fully immunized, 72.3% were partially immunized and 12% were non immunized.
- More males (69.2%) than females (30.7%) were fully immunized.
- There was a significant delay in immunization in males in comparison to historic cohort. (p – value: 0.0001) . Whereas, in females, there was no significant delay (p value: 0.7)
- Amongst Vaginally delivered children 17.6% had no delay in immunization and 82.3% had delay in immunization. Amongst children delivered by LSCS 14.2% had no delay in immunization and 85.7% had delay in immunization.
- There was significant delay in routine childhood immunization in children with <2 birth order before COVID and during COVID period (p-value: <0.001). Whereas in children with >2 birth order, no significant delay was observed before and during COVID. (p-value: 0.55)

- There was a significant delay in immunization in children delivered via LSCS during COVID pandemic (p-value: <0.0001) whereas children delivered via NVD had not very significant delay. (p-value: 0.023)

- In this study, 2.4% infants had a development score below cutoff according to the ASQ-3 staging in all domains (Communication, gross motor, fine motor, personal social, problem solving) at 6 months of age. 2.4% infants continued to have scores below cutoff at 12 months of age in all domains except Fine motor development (3.6%).

- In this study there was no significant delay in development in children born to different gestational ages during COVID period (p-value: 0.5)
- There was no significant delay in development in children with different birth weights during COVID period (p-value: 0.87).
- There was significant delay in development in children with delayed cry during COVID period (p-value: 0.0001).

Conclusions

1. There was no significant delay in development noted in children born to COVID 19 RTPCR positive mothers. Most common association was noted with Delayed cry.
2. There was significant fall in mothers opting for breast feeding during COVID 19 pandemic pertaining to mandatory Quarantine of COVID 19 RTPCR positive individuals. No significant delay was seen in initiation of complementary feeds.
3. There was significant fall in immunization during COVID 19 pandemic, more so in children who had <2 birth order or delivered via LSCS.

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Annexures

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Document Information

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PROFORMA

SANTOSH MEDICAL COLLEGE & HOSPITAL

PATIENT INFORMATION SHEET

Case No.: OPD No/IPD No:

Mother's Name:

Mode of Delivery

Gravida:

Gestation:

Delayed Cry at birth

APGAR 1 min: 5min:

Age :

Sex :

Address:

Phone No:

Condition at discharge:

Anthropometry:

Birth weight: 6 Months: 12 Months:

Height:

Birth Vaccination status:

Feeding history 6 Months: 12 Months:

Development (ASQ 3score)	6 Months	12 Months
Communication		
Gross motor		
Fine motor		
Personal Social		
Problem Solving		

SANTOSH MEDICAL COLLEGE & HOSPITAL

CONSENT FORM

I ……. S/O, D/O ……R/O ……... have been explained by Dr. MANNAT VERMA about the implications and risks of the study. I volunteer to take part in the study titled**" Nutritional status, development and immunization in babies born to covid-19 positive mothers."**I have been explained the purpose of the study to my satisfaction.I hereby give my consent to be enrolled in the study.

Signature of volunteer/guardian

Signature of Investigator

Signature of Witness Phone No.

SANTOSH MEDICAL COLLEGE & HOSPITAL

INFORMED CONSENT FORM

I ……. son/daughter/wife of……. resident of ……. give my full and voluntary consent to be included as a subject in the study"**NUTRITIONAL STATUS, DEVELOPMENT AND IMMUNIZATION IN BABIES BORN TO COVID-19 POSITIVE MOTHERS."** that the study will be conducted in Santosh Hospital. I have been explained, in my own language, and to my full satisfaction, the aim and nature of the study and the risks. I have also been explained that my confidentiality will be maintained, and all the investigations/interventions will be carried out only after my consent is obtained. I am aware of my right to opt out of the study at any point without giving any reason, and without penalty or loss of routine care benefits. My project does not involve any risk.

Thumb Impression/Signature

Name of the Participant

Address of Participant Phone No.-

Date & Time

Dr Mannat Verma Phone No.-

P.G.Student –MD Paediatrics

Santosh Hospital, Ghaziabad

संतोषमेडिकलकॉलेजऔरअस्पताल

सहमतिपत्र

मैं_____ पुत्र / पुत्री /धर्मपत्नी _____ निवासी_____ कोडॉक्टर MANNAT VERMA द्वाराइसशोधकार्यकेसम्बन्धमें"**NUTRITIONAL STATUS, DEVELOPMENT AND IMMUNIZATION IN BABIES BORN TO COVID-19 POSITIVE MOTHERS.**"होनेवालीहानिकेबारेमेंसमझादियाहैऔरमैंइच्छापूर्वकइसशोधकार्यजिसकाशीर्षकहैऔरइसशोधकार्यकेबारेमेंसमझादियागयाहै।अतःमैंउपरोक्तविषयपरशोधकार्यमेंहिस्सालेनेकेलिएसहमतहूँ।मुझेसमझादियागयाहैकीकिसीप्रतिकूलप्रतिक्रियाकेहोनेपरइलाजऔरमुआवजेकीज़िम्मेदारीजांचअधिकारीकीहै।मेरीसभीजानकारीगुप्तरखीजाएगीऔरमुझेकिसीभीसमययहजांचछोड़नेकापूराअधिकारहै।मुझेसमझादियागयाहैकीइसजांचकेदौरानमुझेकोईखतरानहींहै।

हस्ताक्षर जांचअधिकारीकेहस्ताक्षर

गवाह दूरभाषनंबर

दिनांक

Master Chart

MASTER CHART

S.no	Mothers name	Mode of Delivery	Gravida	Gestation	Sex of the baby	Delayed cry at birth	APGAR SCORE at 1 min	APGAR SCORE at 5 min	Condition at discharge	Symptomatic within 14 days	Feeding	Complementary feeds	Baby Birth weight	Weight at 6 months	Weight at 12 months	Status of Birth Vaccination	ASQ-3 SCORE AT 6 months (COMMUNICATION)	ASQ-3 SCORE AT 6 months (GROSS MOTOR)	ASQ-3 SCORE AT 6 months (FINE MOTOR)	ASQ-3 SCORE AT 6 months (PROBLEM SOLVING)	ASQ-3 SCORE AT 6 months (PERSONAL SOCIAL)	ASQ-3 SCORE AT 12 months (COMMUNICATION)	ASQ-3 SCORE AT 12 months (GROSS MOTOR)	ASQ-3 SCORE AT 12 months (FINE MOTOR)	ASQ-3 SCORE AT 12 months (PROBLEM SOLVING)	ASQ-3 SCORE AT 12 months (PERSONAL SOCIAL)
1	B/O Chandrakala	0	1	1	0	0	2	2	0	3	1	2	3	2	2	X	3	3	3	2	3	3	3	3	3	3
2	B/O Rinki	1	1	1	1	0	1	2	1	1	1	1	3	2	2	3	3	3	3	2	3	3	3	3	3	3
3	B/O Monika	1	1	1	1	1	1	2	1	3	1	2	3	2	2	1	1	1	1	1	1	1	1	1	1	1
4	B/O Reena	1	2	1	0	0	1	2	0	3	1	1	3	2	2	3	3	3	3	3	3	3	3	3	3	3
5	B/O Suman Tomar	1	1	1	0	0	1	2	1	3	0	1	3	2	2	2	3	3	3	3	3	3	3	3	3	3
6	B/O Shabnam	0	5	0	1	0	1	2	1	1	2	1	2	2	2	3	3	3	2	2	2	2	3	3	3	3
7	B/O Rakhi	0	1	1	0	0	1	2	0	3	1	2	3	2	2	4	3	3	3	3	3	3	3	3	3	3
8	B/O Sultana	1	1	1	0	0	2	2	0	3	2	0	3	2	2	4	3	3	3	3	3	3	3	3	3	3
9	B/O Sujata Puri	1	2	1	0	0	1	2	0	3	2	1	3	2	2	1	3	3	3	3	3	3	3	3	3	3
10	B/O Pooja Sharma	1	1	1	0	0	1	2	0	3	1	1	3	2	2	3	3	3	3	3	3	3	3	3	3	3
11	B/O Sunita /savita	1	3	1	0	0	1	2	0	3	1	1	3	2	2	1	3	3	3	3	3	3	3	3	3	3
12	B/O Shweta Chaudhary	0	1	1	0	0	1	2	0	3	1	1	3	2	2	2	3	3	3	3	3	3	3	3	3	3
13	B/O Geeta Saini	1	1	1	0	0	2	2	0	3	2	2	3	2	2	3	3	3	3	3	3	3	3	3	3	3
14	B/O Tayba	0	2	1	1	0	1	2	0	3	2	1	3	2	2	4	3	3	3	3	3	3	3	3	3	3
15	B/O Ruksar	1	2	0	0	0	1	2	0	3	1	0	3	2	2	2	3	3	3	3	3	3	3	3	3	3
16	B/O Kiran	0	5	1	0	0	1	2	0	3	1	1	3	2	2	4	3	3	3	3	3	3	3	3	3	3
17	B/O Rajni	1	1	1	0	0	1	2	0	3	1	0	3	2	2	X	3	3	3	3	3	3	3	3	3	3
18	B/O Neelam	0	1	1	1	0	1	2	0	3	0	1	3	2	2	2	3	3	3	3	3	3	3	3	3	3

19	B/O Roshni	1	1	1	1	0	2	2	0	3	2	2	3	2	2	2	3	3	3	3	3	3	3	3	3	3
20	B/O Shayana	0	3	1	1	0	1	2	0	3	0	1	3	2	2	1	3	3	3	3	3	3	3	3	3	3
21	B/O Sangeeta	0	2	1	1	0	1	2	0	2	1	1	3	2	2	3	3	3	3	3	3	3	3	3	3	3
22	B/O Rekha Atri	1	2	1	0	0	1	2	0	3	2	1	2	1	2	4	3	3	3	3	3	3	3	3	3	3
23	B/O Jaymala	0	3	0	1	0	1	2	0	3	1	1	3	2	2	4	3	3	3	3	3	3	3	3	3	3
24	B/O Kajal	0	1	1	0	0	1	2	0	3	0	2	3	2	2	2	3	3	3	3	3	3	3	3	3	3
25	B/O Neha	0	1	1	1	0	1	2	0	3	2	1	3	2	2	2	3	3	3	3	3	3	3	3	3	3
26	B/O Divya	1	1	1	1	0	1	2	0	3	2	1	3	2	2	X	3	3	3	3	3	3	3	3	3	3
27	B/O Shalini Chaudhary	1	2	1	1	0	1	2	0	2	0	2	3	2	2	3	3	3	3	3	3	3	3	3	3	3
28	B/O Pooja	0	5	1	0	0	1	2	0	3	0	1	3	2	2	4	3	3	3	3	3	3	3	3	3	3
29	B/O Soniya Sharma	1	1	1	1	0	1	2	0	2	2	0	2	1	2	2	3	3	3	3	3	3	3	3	3	3
30	B/O Dimpal Sharma	1	4	1	0	0	1	2	0	3	0	2	3	2	2	1	3	3	3	3	3	3	3	3	3	3
31	B/O Ruby Rani	1	2	0	1	0	1	2	0	3	0	2	2	1	2	2	3	3	3	3	3	3	3	3	3	3
32	B/O Usha	1	2	1	0	0	1	2	0	3	1	2	3	2	2	3	3	3	3	3	3	3	3	3	3	3
33	B/O Priyanka	0	1	1	0	1	1	2	0	3	2	1	2	2	2	0	3	3	3	3	3	3	3	3	3	3
34	B/O Kajal	1	1	1	0	0	1	2	0	3	2	2	3	2	2	1	3	3	3	3	3	3	3	3	3	3
35	B/O Shelly	0	1	1	1	1	1	2	1	1	1	0	2	1	2	X	3	3	3	3	3	3	3	3	3	3
36	B/O Ruby	0	3	1	0	0	1	2	0	3	2	1	3	2	2	2	3	3	3	3	3	3	3	3	3	3
37	B/O Geeta	1	2	0	1	0	1	2	0	3	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3
38	B/O Monika	1		1	0	0	1	2	0	3	1	1	3	2	2	2	3	3	3	3	3	3	3	3	3	3
39	B/O Uma Sharma	1	3	0	0	0	1	2	1	1	2	0	3	2	2	1	3	3	3	3	3	3	3	3	3	3
40	B/O Umesh Kumari	1	3	1	1	0	1	2	0	3	0	2	3	2	2	3	3	3	3	3	3	3	3	3	3	3
41	B/0 Jigyasa Devi	1	1	1	1	0	1	2	0	3	0	1	3	2	2	1	3	3	3	3	3	3	3	3	3	3

42	B/O Kajal Gupta	1	3	1	0	0	1	2	0	3	2	2	3	2	2	2	3	3	3	3	3	3	3	3	3	3
43	B/O Sonika Rana	1	2	1	1	0	1	2	0	3	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3
44	B/O Ruby	0	1	1	1	1	1	1	1	1	2	1	2	1	2	0	1	1	1	1	1	1	1	1	1	1
45	B/O Sheetal	1	1	1	0	0	1	2	0	3	0	2	3	2	2	0	3	3	3	3	3	3	3	3	3	3
46	B/O Nagina	1	2	1	0	0	1	2	0	3	1	2	2	2	2	0	3	3	3	3	3	3	3	3	3	3
47	B/O Soni Sharma	0	3	1	0	0	1	2	0	3	0	1	3	2	2	1	3	3	3	3	3	3	3	3	3	3
48	B/O Neha	0	3	1	1	0	1	2	0	3	0	1	3	2	2	1	3	3	3	3	3	3	3	3	3	3
49	B/O Renu	0	1	1	1	0	1	2	0	3	2	1	3	2	2	1	3	3	3	3	3	3	3	3	3	3
50	B/O Nita Verma	0	2	1	0	0	1	2	0	3	0	1	2	2	2	1	3	3	3	3	3	3	3	3	3	3
51	B/O Neetu	0	2	1	1	0	2	2	0	2	0	2	2	2	2	1	3	3	3	3	3	3	3	3	3	3
52	B/O Divyashi Agarwal	1	1	1	0	0	1	2	0	3	1	2	3	2	2	2	3	3	3	3	3	3	3	3	3	3
53	B/O Sugandha	1	4	1	0	0	1	2	0	3	2	1	3	2	2	3	3	3	3	3	3	3	3	3	3	3
54	B/0 Aarti	0	3	1	0	0	1	2	0	3	2	2	3	2	2	X	3	3	3	3	3	3	3	3	3	3
55	B/O Aparna	1	1	1	1	0	1	2	0	3	2	1	2	1	2	0	3	3	3	3	3	3	3	3	3	3
56	B/O Durga	1	1	0	0	0	1	1	1	1	1	1	3	2	2	1	3	3	3	3	3	3	3	3	3	3
57	B/O Kamlesh	1	1	1	0	0	1	2	0	3	2	2	3	2	2	2	3	3	3	3	3	3	3	3	3	3
58	B/O Manju Gupta	1	3	1	1	0	1	2	0	3	2	1	3	2	2	2	3	3	3	3	3	3	3	3	3	3
59	B/0 Archana	1	3	1	0	0	1	2	0	3	0	1	3	2	2	1	3	3	3	3	3	3	3	3	3	3
60	B/O Sanju	1	4	0	0	0	1	2	0	3	2	2	1	1	1	X	3	3	2	2	2	2	2	1	3	2
61	B/O Kanchan	1	2	0	0	0	1	2	0	3	2	1	2	1	2	2	3	3	3	3	3	3	3	3	3	3
62	B/O Prerna Khushboo	1	1	1	1	0	1	2	0	3	1	1	3	2	2	2	3	3	3	3	3	3	3	3	3	3
63	B/O Kavita	1	3	0	1	0	1	2	1	1	1	1	2	1	2	3	3	3	2	3	3	3	3	3	3	3
64	B/O Nidhi Sachan	1	2	1	0	0	1	2	0	3	0	1	3	2	2	3	3	3	2	3	3	3	3	3	3	3
65	B/O Sushma	1	3	0	1	0	1	2	0	2	2	2	2	2	2	0	3	3	2	3	3	3	3	3	3	3

66	B/O Sunita Pal	0	2	0	0	0	1	2	0	3	2	1	2	1	2	2	3	3	3	3	3	3	3	3	3	3
67	B/O Divya	1	1	1	1	0	1	2	0	3	0	2	3	2	2	2	3	3	3	3	3	3	3	3	3	3
68	B/O Neelam Rani	1	2	0	0	0	1	2	0	3	0	1	3	2	2	0	3	3	3	3	3	3	3	3	3	3
69	B/O Anchal	1	1	1	0	0	1	1	1	1	0	1	3	2	2	0	3	3	3	3	3	3	3	3	3	3
70	B/O Ruchi	0	3	1	1	0	1	2	0	3	0	2	3	2	2	4	3	3	3	3	3	3	3	3	3	3
71	B/O Akanksha	0	2	1	1	0	1	2	0	3	0	1	3	2	2	1	3	3	3	3	3	3	3	3	3	3
72	B/O Sambhavi	0	1	1	1	0	1	2	0	3	2	1	3	2	2	2	3	3	3	3	3	3	3	3	3	3
73	B/O Anju	1	1	1	1	0	1	2	1	1	2	1	2	1	2	2	3	3	3	3	3	3	3	3	3	3
74	B/O Radha	1	1	1	1	0	1	2	1	1	2	1	2	1	2	1	3	3	3	3	3	3	3	3	3	3
75	B/O Rita	0	2	1	1	0	2	2	0	3	0	1	3	2	2	1	3	3	3	3	3	3	3	3	3	3
76	B/O Neelam	1	1	1	0	0	1	2	1	1	0	2	3	2	2	0	3	3	3	3	3	3	3	3	3	3
77	B/O Tanu Kumari	0	1	1	0	0	1	2	1	1	2	2	3	2	2	0	3	3	3	3	3	3	3	3	3	3
78	B/O Gulestha	0	4	1	1	0	1	2	0	3	2	2	3	2	2	0	3	3	3	3	3	3	3	3	3	3
79	B/O Preeti-Twin 1	0	2	0	0	0	1	2	0	3	1	0	2	1	1	0	3	3	3	3	3	3	3	3	3	3
80	B/O Preeti-Twin 2	0	2	0	0	1	1	2	0	3	1	1	2	2	2	0	3	3	3	3	3	3	3	3	3	3
81	B/O Priyanka	0	1	1	0	0	1	2	0	3	1	1	2	2	2	X	3	3	3	3	3	3	3	3	3	3
82	B/O Jyoti Gupta	0	3	1	1	0	1	2	0	3	1	2	3	2	2	X	3	3	3	3	3	3	3	3	3	3
83	B/O Rony VC	1	2	0	1	0	1	2	0	3	1	1	2	1	2	X	3	3	3	3	3	3	3	3	3	3

KEY TO MASTER CHART

SEX	
Male	0
Female	1
GESTATION	
Preterm	0
Term	1
MODE OF DELIVERY	
NVD	0
LSCS	1
GRAVIDA	
Primi	1
Gravida 2	2
Gravida 3	3
Gravida 4	4
Gravida 5	5
Gravida 6	6
DELAYED CRY AT BIRTH	
Yes	0
No	1
BIRTH WEIGHT	
<1 Kg(ELBW)	0

1-1.49 Kg(VLBW)	1
1.5-2.49 Kg(LBW)	2
>2.5-3.9 kg	3
>4 Kg	4

APGAR SCORE @ 1 Min

<4	0
4-7	1
>7	2

APGAR SCORE @ 5 Min

<4	0
4-7	1
>7	2

CONDITION AT DISCHARGE

Handed over and sent home	0
NICU admission	1

COURSE IN FIRST 14 DAYS OF LIFE

Expired	0
Symptomatic at birth	1
Symptoms developed later	2
Asymptomatic	3

FEEDING for FIRST 6 MONTHS	
Exclusive breastfeeding	0
Formula feeding/Animal Milk	1
Mixed Feeding(Breastfeeding + Formula/Animal Milk)	2

BIRTH VACCINATION	
Not done	X
At birth	0
Within 7 days	1
Within 14 days	2
Within 1 month	3
>1 month	4

ASQ-3 SCORE AT 6 months (COMMUNICATION)	
below cutoff	1
borderline	2
above cutoff	3

ASQ-3 SCORE AT 6 months (GROSS MOTOT)	
below cutoff	1
borderline	2

above cutoff	3
ASQ-3 SCORE AT 6 months (FINE MOTOR)	
below cutoff	1
Borderline	2
above cutoff	3
ASQ-3 SCORE AT 6 months (PROBLEM SOLVING)	
below cutoff	1
Borderline	2
above cutoff	3
ASQ-3 SCORE AT 6 months (PERSONAL SOCIAL)	
below cutoff	1
Borderline	2
above cutoff	3
ASQ-3 SCORE AT 12 months (COMMUNICATION)	
below cutoff	1
Borderline	2
above cutoff	3

ASQ-3 SCORE AT 12 months (GROSS MOTOT)	
below cutoff	1
Borderline	2
above cutoff	3
ASQ-3 SCORE AT 12 months (FINE MOTOR)	
below cutoff	1
Borderline	2
above cutoff	3
ASQ-3 SCORE AT 12 months (PROBLEM SOLVING)	
below cutoff	1
Borderline	2
above cutoff	3
ASQ-3 SCORE AT 12 months (PERSONAL SOCIAL)	
below cutoff	1
borderline	2
above cutoff	3